2018

Independent Engineering Inspection of the DC Water Wastewater and Water Systems

Johnson, Mirmiran & Thompson, Inc.
3/25/2018

Contents

SECTION 1 INTRODUCTION

1.1 PURPOSE

This report presents the findings of an independent engineering assessment of District of Columbia Water and Sewer Authority's (DC Water's or the Authority's) wastewater and water systems, pursuant to the requirements of the Authority's Master Indenture of Trust. The indenture stipulates that:

> ***"The Authority shall cause an independent consulting engineer at least once every five years to inspect the system and make a written report thereof which shall include such independent engineer's findings and recommendations as to the maintenance of the system and the construction of additions, extensions and improvements to the system and capital replacements thereof."***

DC Water retained Johnson, Mirmiran & Thompson, Inc. (JMT) of Hunt Valley, MD to conduct the Independent Consulting Engineer Assessment. The previous Independent Consulting Engineer Assessment was prepared by JMT in 2013 (the "2013 Assessment"). This five-year recurring audit of the current state of facilities and DC Water's initiatives is executed to comply with the Master Indenture of Trust (quoted above). This report contains a summary of findings and subsequent recommendations. The information contained within this report is effective as of this draft date of March 25, 2018.

1.2 SCOPE AND METHODOLOGY

This report summarizes the findings and assessments of the Independent Consulting Engineer based on site inspections and interviews with key DC Water and Washington Aqueduct supervisory staff and members of the Program Management Team. Inspections and interview questions focused on the following topics related to water, wastewater and stormwater treatment and conveyance assets:

- Physical condition of assets
- Governance and management processes
- Site assessment of construction activities for capital projects
- Safety programs and risk management
- Current and future capital programs
- Operations and Maintenance
- Cost and schedule performance of construction activities for capital projects
- Consent decree and permit compliance

In addition to site visits and staff interviews, JMT also reviewed documents and reports prepared by DC Water staff, Washington Aqueduct staff or consultants retained by either agency. Additional reports and memoranda from agencies responsible for the Potomac River were instrumental in assessing the viability of the river as a dependable source of water. A comprehensive list of the documents reviewed is listed in the Bibliography attached to the end of this report. A few key reports include:

- FY 2017-2026 Capital Improvement Program (CIP) - DC Water
- FY 2018 Operating and Capital Budgets
- D.C. Clean Rivers Biannual Status Reports
- FY 2018-2027 Capital Improvement Plan - Washington Aqueduct
- 2015 Water and Sewer System Facilities Plans (2015 Facilities Plan Updates)
- 2015 NPDES Permit (Permit # DC0021199)
- 2013 Independent Engineering Inspection (the 2013 Assessment)
- DC CLEAN RIVERS PROJECT: 2018 Anacostia River Tunnel System Overview
- Testimonies of General Manager to DC Council for Performance Oversight FY 2016 & FY 2017

JMT's approach to the 2018 Independent Engineering Assessment (the 2018 Assessment) was methodical with the intent to produce an independent assessment while incorporating key staff input. JMT conducted independent research and prepared notes for each interview to minimize disruption. Detailed interview notes were taken, and field observations were documented for inclusion in the report. JMT visited and inspected many facilities as listed in this section. All safety measures were followed and the safety and health measures at each facility were evaluated.

The 2018 Assessment contains performance observations based on the 2013 Assessment's considerable construction activities. The 2018 Assessment was conducted during a period in which DC Water has undertaken innumerable projects and initiatives. The scope and ambition of these efforts are notable both within the history of DC Water and within the overall water utility industry. During the intervening period, comprehensive and aggressive construction activities continued to meet scheduled milestones for Consent Decrees (CSO-LTCP & TN/WW) and NPDES permit requirements. While many construction projects were commissioned in response to the mandates of regulatory orders, consent decrees, and permit requirements, other organizational initiatives have been undertaken in the interest of increasing efficiency, improving management and operations, and significant improvements in customer service.

Not all facilities were inspected; however, efforts have been made to ensure a significant and representative sample of all operational facilities were observed during the inspections. JMT used professional judgment to ascertain where inspections were required versus where document research and interviews resulted in confidence in the condition of any other particular asset. All findings, conclusions and recommendations take into account professional judgments regarding the implications for future system performance and impacts on DC Water and Washington Aqueduct stakeholders.

A critical aspect part of JMT's information gathering process involved interviews with key DC Water and Washington Aqueduct Staff, as listed in **Exhibit 1-1**. JMT also attended a DC Water Board of Directors meeting to obtain key information about the organization's capital programs and operations.

Exhibit 1-1: Summary of Interviews with DC Water and Washington Aqueduct Staff

Interviewee Department/Title	Interviewee Name(s)
Chief Engineer	Leonard Benson, Craig Fricke
Engineering & Technical Services	Leonard Benson, Craig Fricke, and William Elledge
Wastewater Engineering	Diala Dandach
Wastewater Treatment, Blue Plains Advanced Wastewater Treatment Plant and Treatment Technologies	Aklile Tesfaye (Assistant General Manager, Blue Plains), Christine deBarbadillo, Salil Kharkar, and Wendell Smith
DC Clean Rivers Project	Carlton Ray (Director), Bethany Bezak, Moussa Wone, Brandon Flora
Assistant General Manager Customer Care & Operations	Charles Kiely
Director Utility Services - Sewer	Cuthbert Braveboy, Dunbar Regis, Sigrun Sharp
Director Utility Services - Water	Jason Hughes
Director Distribution and Conveyance Systems	Chuck Sweeney
Manager Linear Asset Management	Nichol Sowell
Finance and Budget	Syed Khalil, Suzette Stona
Washington Aqueduct	Thomas Jacobus (General Manager) and Leo Nolan
Washington Aqueduct Planning & Engineering Branch	Nathan Cole (Chief)
DC Water Board of Directors - Meeting of the Environmental Quality & Operations Committee - 1/18/18	DC Water Board of Directors Committee members

JMT conducted site visits and performed inspections on major facilities that were made accessible to its staff. Where applicable, unanticipated site conditions and cost/schedule impacts described during interviews were recorded, along with the existence of applicable recovery schedules. For work sites where some construction activities were taking place, JMT focused attention on reviewing construction progress and comparing that progress to contract documents. For sites not undergoing construction activities, the focus of JMT facility inspections was on conformance to industry standards, applicable codes, and safety. Photographs were taken at most of the sites to document the visits and conditions inspected; however, JMT was sensitive to security concerns. Site visits conducted are listed in **Exhibit 1-2**.

Exhibit 1-2: DC Water and Washington Aqueduct Facilities Visited and Inspected

Facilities Inspected	
• Blue Plains Advanced Wastewater Treatment Plant (Blue Plains)	• Blue Plains Tunnel Dewatering Pumping Station (TDPS) <<
• Blue Plains Control Center & Process Control System	• Northeast Boundary Tunnel (NEBT) << North Shaft
• O Street Wastewater Pumping Station	• CSO 019
• Main Wastewater Pumping Station	• CSO-017 & M Street Diversion
• Bryant Street Water Pumping Station	• CSOs 015 & 016
• Dalecarlia Water Treatment Plant	• CSO 005 & CSO 007 <<
• Dalecarlia Residuals/Solids Recovery Facility	• Main Outfall Sewer Diversion Facility <<
• Dalecarlia Water Treatment Plant	• Main Pumping Station Drop Shaft <<
• Dalecarlia Pumping Station	• CSOs 009, 0010, 011, 011a (B St./New Jersey Avenue) <<
• Blue Plains Tunnel	• CSO 012 Tiber Creek
• McMillan Water Treatment Plant	• Enhanced Clarification Facility (ECF) <<
• Fleet Maintenance Shop	• CSO-018 Diversion Facility <<
• Poplar Point Pumping Station (New) <<	• First Street Tunnel and Temporary Pumping Station
• Fort Reno Water Pumping Station	• Fort Reno Elevated Tank #2 (out of service)
• Fort Reno Reservoir	• Eastside Wastewater Pumping Station
• Potomac Wastewater Pumping Station	• Swirl Facility
• Sewer Services Operation Building	• Tingey Street Diversion Facilities
Note: “<<” Indicates facility is Under Construction	

1.3 JOHNSON, MIRMIRAN & THOMPSON, INC. QUALIFICATIONS

For more than 45 years, Johnson, Mirmiran & Thompson, Inc. (JMT) has provided quality engineering services to clients in the Mid-Atlantic region and has served federal agencies throughout various states. JMT is a full service, multi-disciplined consulting firm and performs as program managers for many agencies, including water and sewer agencies, airports, state agencies, educational institutions, and transportation authorities. JMT is staffed by practicing engineers of all major disciplines and retains former public officials and academics in order to provide broad experience and skill sets to our clients and to the public served by our clients.

1.4 A NOTE OF THANKS

The JMT team wishes to express its appreciation to the DC Water managers and staff who graciously took the time to discuss DC Water's achievements over the past five years while also conveying their professional pride and enthusiasm in the organization and its mission. The interviewers also wish to thank the Washington Aqueduct managers for their collaboration with JMT as we reviewed the Aqueduct's achievements over this reporting period.

SECTION 2 DC WATER OVERVIEW

2.1 VISION, VALUES, AND MISSION, AND CRITICAL SUCCESS FACTORS

As part of these assessments, JMT has reviewed DC Water's vision, mission, goals, objectives, initiatives values, and critical success factors. The DC Water Board of Directors adopted the Vision, Mission, Values and Critical Success Factors on July 3, 2008. The Blue Horizon 2020 Strategic Plan (adopted in March 2013 and revised in 2015) updated the statements as presented below. This 2018 Assessment was performed with mindfulness of how DC Water's staff incorporates its vision, values, and mission into their roles and daily responsibilities.

DC Water's Vision

To be a world-class water utility.

DC Water's Values

Respectful – Serve with a positive attitude, courtesy, and respect that engender collaboration and trust.

Ethical – Maintain high ethical standards, accountability, and honesty as we advance the greater good.

Vigilant – Attend to public health, the environment, quality, efficiency, and sustainability of our enterprise.

Accountable – Address challenges promptly, implement effective solutions, and provide excellent service as a committed team.

DC Water's Mission

Exceed expectations by providing high quality water services in a safe, environmentally friendly, and efficient manner.

Focus Areas

Leadership – DC Water will advocate and lead local, regional, and national collaborations, while internally developing the workforce of the future.

Value – DC Water will be recognized for the value it delivers by protecting public health and the environment, supporting community sustainability, and providing for economic vitality.

Innovation – DC Water will achieve international prominence in development and adoption of science, technology and processes in support of a culture of innovation.

DC Water's Goals

1. Develop, Maintain, and Recruit a High Performing Workforce
2. Collaborate Locally, Regionally, Nationally, and Internationally
3. Increase Board Focus on Strategic Direction
4. Enhance Customer and Public Confidence, Communications, and Perception
5. Promote Financial Sustainability, Integrity, and Responsible Resource Allocation
6. Assure Safety and Security
7. Maximize Water Quality Treatment, Compliance, and Efficiency
8. Optimally Manage Infrastructure
9. Enhance Operating Excellence through Innovation, Sustainability, and Adoption of Best Practices

Each strategic goal also provides specific objectives and initiatives that enable the achievement of the goal.

2.2 GOVERNANCE AND ORGANIZATION

2.2.1 GOVERNANCE

DC Water's 22-Member Board of Directors establishes policies and guides the strategic planning process. DC Water is governed by a Board of Directors consisting of 11 principal and 11 alternate members, each appointed for a staggered four-year term. Six principal members (appointed by the Mayor of the District of Columbia – the District – with the advice and consent of the District Council) represent the District and five principal members (appointed by the Mayor on recommendations of the wholesale customers) represent the wholesale customers, two each from Prince George's and Montgomery Counties (jurisdiction of Washington Suburban Sanitary Commission - WSSC) in Maryland, and one from Fairfax County, Virginia.

The powers of DC Water are vested in and exercised by the Board at meetings duly called and held where a quorum of at least six members is present. All Board members participate in decisions directly affecting the management of joint-use facilities which are those facilities used by all three jurisdictions. Only the District members participate in those matters that affect District ratepayers and in setting fees for services that affect only District residents. The Board meets monthly and operates through various committees. The standing committees include Finance and Budget, District of Columbia Retail Water and Sewer Rates, Environmental Quality and Operations, Human Resource and Labor Relations, Audit, Governance, and Strategic Planning. Additional standing or ad-hoc committees may also be formed to serve specific functions not served by the standing committees

Article 3.01 of the DC Water Board of Director's By-Laws defines what a "meeting" is and how meetings are to be conducted in relation to the public. All meetings are open to the public and the news media. Meetings are required to be documented by transcription and/or by electronic recording devices, as well as video, and those documents shall be made available to the general public. Article 4.01 of the DC Water Board of Director's By-Laws defines the officers of the Board, their duties, term in office and resignation and removal of officers. The selected Chairperson's duties include: calling emergency meetings, determining agenda, presiding over meetings, establishing Committees and appointing members to Committees. A nominating committee elected Vice-Chairperson has the authority to execute the duties of the Chairperson in their absence.

Article 5.01 of the DC Water Board of Director's Bylaws establishes standing Committees of the Board. There are seven standing Committees of the Board:

- Finance and Budget Committee
- Environmental Quality and Operations Committee
- Audit Committee
- Strategic Planning Committee
- District of Columbia Retail Water and Sewer Rates Committee
- Human Resources and Labor Relations Committee
- Governance Committee

The Board of Directors can create additional Committees as it deems necessary; the principal duty of any Committee shall be to recommend proposed action to the Board of Directors.

Article 6.01 of the DC Water Board of Director's Bylaws gives the Board the authority to hire a General Manager who will be the chief administrative officer of DC Water. The General Manager candidate requires the affirmative vote of eight voting members to become the DC Water General Manager. The General Manager has supervisory and management responsibilities concerning DC Water's business, affairs, agents and employees. The General Manager can be removed from his/her position by eight affirmative votes from the Board.

A representative from JMT attended the DC Water Board of Director's Environmental Quality and Operations Committee Meeting on January 18, 2018. The Committee members viewed presentations by some of DC Water's key managers who reported on the proposed FY 2018 - 2027 Capital Budget. The following are key topics that were covered in that presentation.

- 10-year CIP recommendations
- Funding level scenarios to provide baseline, or enhanced levels of service
- Needed capital improvements to maintain the system over the long-term
- Assessments of the adequacy of funding levels for various operational lines of service
- The risks of underfunding capital improvements in sanitary sewer due to regulatory requirements in other areas

- Projections of future needs in sanitary sewer CIP based on asset management principles

In the assessor's professional opinion, the meeting observed on January 18, 2018 was indicative of a well-run and professional organization. Committee members considerately engaged in discussion with the DC Water managers to ensure proper understanding of the budget cases presented. The DC Water managers presented budget cases founded on sound engineering principles and modern industry practices. DC Water ensures organizational transparency by making meeting schedules and materials available online and making meetings accessible to the public. The new Administrative Headquarters (HQO) will make meetings even more accessible to the public.

The Committee members showed a high level of engagement and concern in the success of DC Water operations. Examples of these assertions for the January 18, 2018 meeting are outlined below:

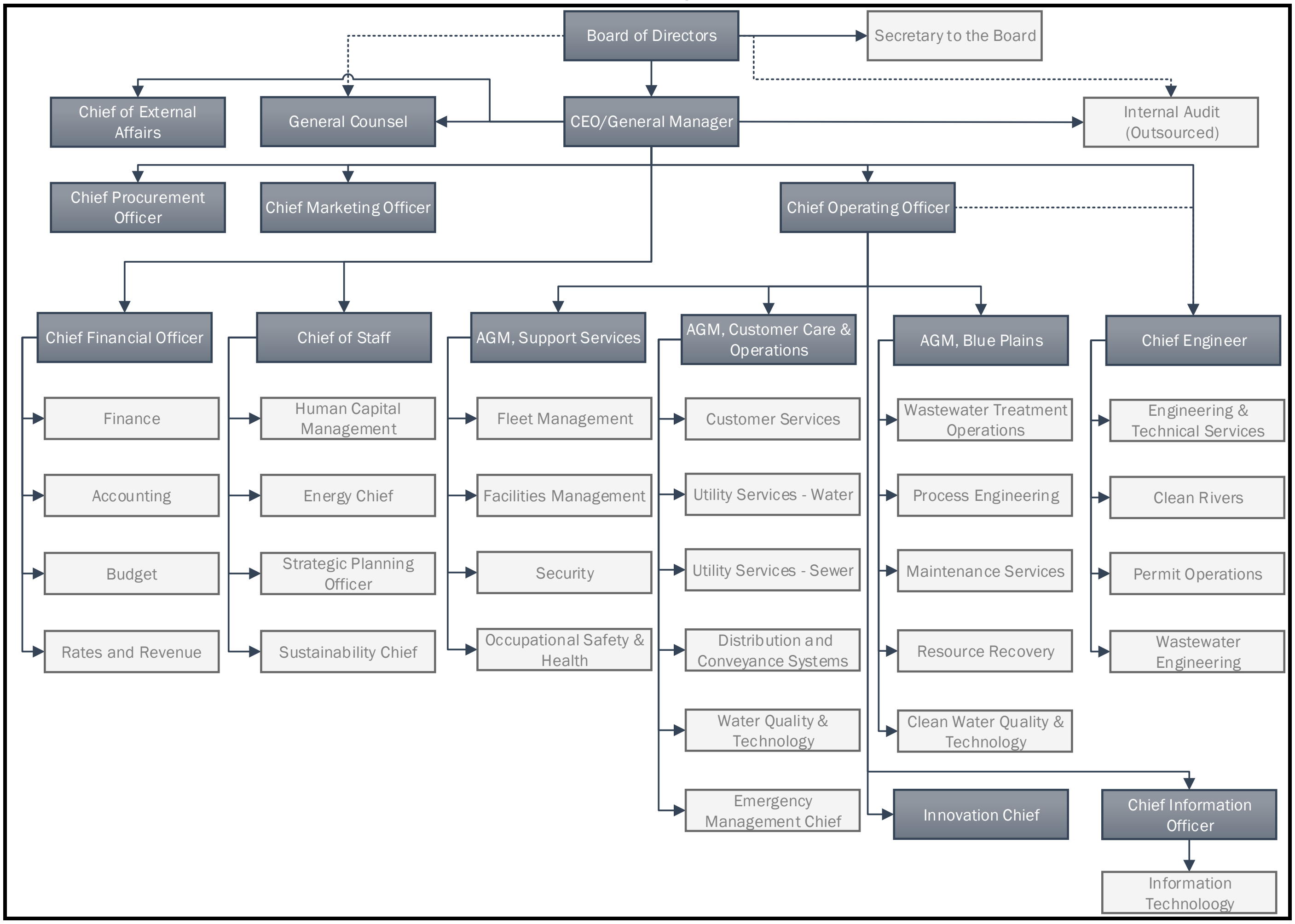
- The meeting was easily accessible to the general public. The schedule and agenda were readily available online through the DC Water website, an indication of organizational transparency.
- The board members appeared attentive to steering the management of the utility. Board members were knowledgeable about the current policies and practices engaged in by the utility in managing its infrastructure.
- Although the Committee generally declined to approve increased funding for Capital improvements proposed by DC Water's management, reasoning was sound, citing the cost of service and affordability to customers, particularly those within the District's lower income brackets.
- The Committee was not dismissive of the case presented by DC Water's management. They requested the management team to re-evaluate the proposed methods of funding for needed improvements and provide an assessment of whether those improvements can be funded through other means. The apparent intent was to fund needed improvements in future budgets while also ensuring that persistent rate increases are not considered a primary means of funding improvements unless necessary.

The January 18, 2018 Committee meeting is viewed as representative of previous meetings based upon JMT attendance at other meetings, review of earlier meeting handouts and minutes, and feedback from DC Water staff during interviews.

2.2.2 ORGANIZATION

DC Water's current organizational chart is shown as **Exhibit 2-1**. The organization continues to evolve as DC Water conducts internal analysis and studies that identify opportunities to improve effectiveness and reduce costs.

Exhibit 2-1: DC Water Organizational Chart



At the end of FY 2016, DC Water had 1,121 filled positions out of an authorized total of 1,260. Over the long term, the authorized staffing level is a reduction of 20% from 1,508 positions authorized in FY 1998. Since the 2013 Assessment, however, authorized staffing levels at DC Water remained constant. There are 1,260 positions approved for FY 2018, the same number of positions in 2013. The actual staffing level increased through the filling of vacant positions, with 1,121 positions filled at the close of FY 2016 (per the Approved FY 2018 Budget.) During interviews with engineering and operational managers, the interviewers found a considerable amount of analysis being performed to balance in-house workloads and outsourcing engineering and contractual services.

The increased staffing from 2013 levels addresses service to customers and operational quality as defined by the Critical Success Factors, thereby elevating services since the 2013 Assessment. In fact, customer service capabilities were a topic of pride with the interviewed managers and staff. The morale of interviewed staff and encountered personnel is, in the opinion of JMT, above the levels in evidence in many of the other public agencies studied or observed. During the intervening years between the 2013 assessment and this 2018 assessment, gains have been achieved in the public and employee branding for

DC Water. Later in this report, Asset Management cooperation between departments will substantiate this identity of DC Water.

DC Water provides its employees with comprehensive fringe benefit packages, including coverage for: health insurance, group term life insurance, dental care, vision care, disabilities and retirement plans. It also has undertaken efforts to provide staff with modern office spaces that reflect the importance of their day-to-day missions.

2.3 MANAGEMENT AND OPERATIONS

The Board and General Manager are actively involved in the operation and management of DC Water. Through interviews, executive and senior managers indicated that they are provided with the tools and resources to fulfill DC Water's mission. Staffing levels, facilities, budgets, and schedules are adequately vetted and planned. Training initiatives were apparent during this review period. The level of communications is well-documented. The DC Water website ensures transparency and is a source of pride within the engineering and operations staff. Knowledge and direction of current activities were expressed by interviewed managers, indicating that all sections had an understanding and agreement with the overall focus and status of DC Water efforts and successes.

Through the course of this assessment, the JMT team met with numerous managers within the organization. During these interviews, it was apparent that during the past five years, significant reorganization and optimization efforts have been undertaken in the operations of the utility. These efforts appear, in the opinion of the assessors, to be successful in creating operational improvements where needed. The concentration of technical expertise in wastewater facilities engineering, and in operation of distribution and conveyance systems are cited as examples of continual improvement toward operational excellence. Clustering linear assets within one engineering team and grouping the 'vertical' assets into another team follows industry trends as buried infrastructure and building components and systems are two distinct engineering disciplines. Development of a centralized asset management strategy and decentralized implementation programs at the appropriate operational areas are also cited as evidence of continued improvement efforts.

In addition to management and organizational initiatives, DC Water has actively sought and implemented cutting-edge technology improvements across the full spectrum of its operations. At all levels of the utility, DC Water staff are equipped with industry standard or better technology to achieve their mission. Funding of training, research and development, and technical paper presentations have placed DC Water in the vanguard of agencies employing emerging technologies and cost-saving efficiencies.

2.3.1 BUDGETING

Each fiscal year, DC Water produces an annual operating budget and a 10-year CIP. Both documents are subject to public review and comment prior to their approval by the Board of Directors. DC Water's financial management system monitors spending to prevent unauthorized expenditures. The Department of

Finance, Accounting and Budget prepares reports that are reviewed monthly to ensure compliance with authorized budgets.

Since its creation in 1996, DC Water's Board has adopted policies that support financial planning and promote reliable revenue forecasting. Given the agency's substantial borrowing needs to support its capital projects and large-scale investment, DC Water's continuing adherence to these policies supports its ability to cost-effectively access the capital markets and retain credibility with customers and regulators.

DC Water maintains financial practices and policies that are intended to maintain a high-quality investment-grade bond rating to ensure the lowest practical cost of debt necessary to finance DC Water's long-term capital program. The current financial policies set by the Board through resolution 13-57 are summarized below.

- DC Water maintains strong levels of operating cash reserves, equivalent to 120 days of budgeted operations and maintenance costs, $125.5 million or greater in operating reserves.
    - The annual reserve amount is formally approved by the Board as part of its annual approval of the operating and capital budgets.
    - The operating reserve requirement is re-evaluated every five years by DC Water's independent rate consultant in conjunction with the Indenture-required system assessment.
- The operating reserve will, at a minimum, include any reserve requirements contained in the Indenture, excluding any debt service reserve funds and the rate stabilization fund as follows.
    - Operating reserve – equivalent to 60 days' operating costs.
    - Renewal & replacement reserve – $35 million. This reserve requirement will also be evaluated every five years by the independent rate consultant in conjunction with the Indenture-required system assessment.
- DC Water establishes strong debt service coverage in excess of the requirements that are stated in the Indenture.
- DC Water uses operating cash exceeding the reserve requirements, along with any significant one-time cash infusions for capital financing or for repayment of higher cost debt.
- Whenever possible, DC Water uses the least costly type of financing for capital projects, based on careful evaluation of DC Water's capital and operating requirements and financial position for each year.
- DC Water attempts to match the period of debt repayment, in total, with the service life of each of the assets financed by any such debt.
- DC Water finances its capital equipment needs with operating cash or short-term financing instruments with the same or shorter lives as the related assets. DC Water issues commercial paper notes, classified as subordinate debt under the Indenture, as a solution for its short-term financing needs.
- Over the past five years, DC Water has proven innovative through its bond offerings. In 2014, DC Water issued its inaugural "green bond" to investors in funding a portion of the DC Clean Rivers Project. This $350 million issuance marked the first green bond issued in the United States to be supported by an independent "Second Party Opinion" and the first 100-year "Century" bond issued by a municipal water utility. Three such bonds have been issued to date in support of the environmental mission of the Clean Rivers Project.
- DC Water continues pioneering project financing through green bonds, century bonds, and recently introduced the nation's first Environmental Impact Bond (EIB). The EIB's return rate

is tied to project performance, specifically, the effectiveness of green infrastructure in its management of stormwater.

During FY 2016, Standard and Poor's Investors Service (S&P), for the first time in history, upgraded DC Water's credit rating to "AAA" for senior lien revenue bonds. The "AAA" rating is the highest rating issued by the rating agency. Subsequently, Moody's Investor Services upgraded DC Water's credit rating to "Aa1" for senior lien revenue bonds. Additionally, the green bonds are assessed at "GB1" by Moody's.

The DC Water Board of Directors strives to meet the following goals in its retail rate setting. The following are guiding principles to the rate setting process.

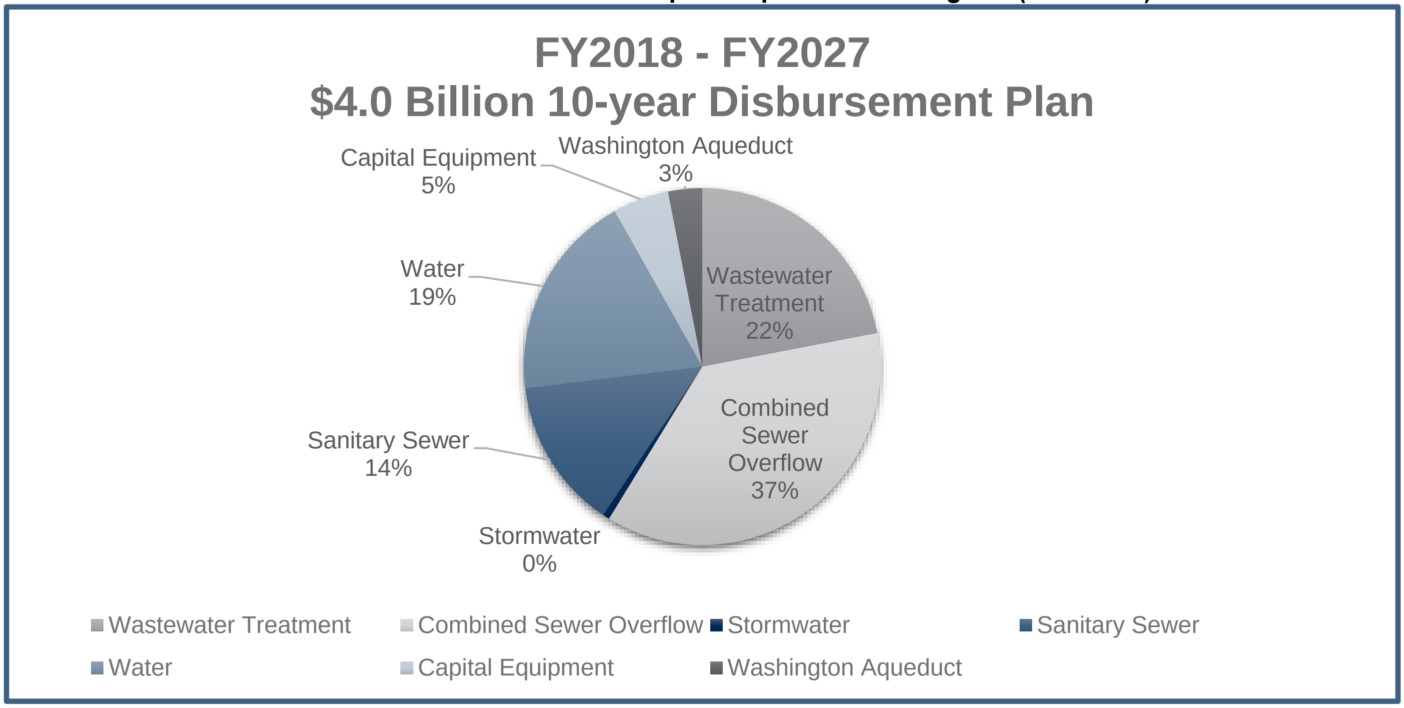
- Rates that, together with other revenue sources, cover current costs and meet or exceed all bond and other financial requirements.
- Rates that yield a reliable and predictable stream of revenues.
- Rates based on annually updated forecasts of operating and capital budgets.
- Rates structures that are legally defensible.
- Rates structures that customers can understand.
- Rate increases, if required, that are implemented transparently and predictably.
- To the extent annual revenues exceed costs, the Board will utilize available options to mitigate future customer impacts and annual rate increases, including transferring excess funds to the Rate Stabilization Fund.

2.3.2 FACILITIES PLANNING AND CAPITAL PROGRAMMING

DC Water is required by enabling legislation to adopt and submit a financial plan incorporating operating and capital costs with a minimum period of five-years. DC Water continues to surpass that requirement by annually adopting a ten-year Financial Plan and Capital Improvement Program that manages the capital investments necessary to fulfill its mission, to comply with regulatory requirements and to preserve its infrastructure.

DC Water's adopted FY 2017 – FY 2026 CIP is budgeted for $3.75 billion for the 10-year period. At this writing, full details of the FY2018 – FY 2027 CIP were not yet available, but summary documents show this budget will increase over the previous 10-year rolling budget to $4.00 billion. This budget includes disbursements for improvements to the Blue Plains Advanced Wastewater Treatment Plant (Blue Plains), combined sewer overflow system, sanitary sewer and stormwater collection systems, water pumping and distribution system, capital equipment and the Washington Aqueduct. The distribution of the 10-year CIP is shown in **Exhibit 2-2** below.

Exhibit 2-2: FY 2018 – FY 2027 Capital Improvement Program ($ in 000's)



DC Water develops and prioritizes capital projects based on a specific set of criteria and requirements:

- **Court Ordered, Stipulated Agreements, etc. –** Projects that are undertaken to comply with court orders, stipulated agreements, regulatory requirements and requirements of Authority's the National Pollution Discharge Elimination System (NPDES) permits.
- **Health and Safety –** Projects that are required to eliminate or mitigate impacts on public health or safety and/or to ensure compliance with NPDES permit requirements.
- **Board Policy, DC Water's Commitments to Outside Agencies –** Projects resulting from policies/resolutions of the Board and outside agency commitments.
- **Potential Failure, Ability to Continue Meeting Permit Requirements –** Projects undertaken to construct/rehabilitate facilities and/or equipment in danger of failing and thus endangering the ability to continue meeting permit requirements.
- **High Profile, Good Neighbor Policy –** Projects undertaken to address concerns expressed by public officials or citizens.
- **Good Engineering, High Payback, Mission/Function –** Projects that are needed for rehabilitation/upgrade of facilities and infrastructure that are mission critical, projects that resolve operational issues and inefficiencies that result in operational and maintenance cost savings.
- **Good Engineering, Low Mission/Function over Long-term –** Projects that are needed for rehabilitation/upgrade of facilities and infrastructure but are lower priority.

2.3.3 PROJECT DELIVERY

DC Water relies on its Department of Engineering and Technical Services (DETS), Wastewater Engineering, and DC Clean Rivers Project (DCCR or Clean Rivers) to plan and execute its major capital projects. Additional project delivery is performed by DC Water groups such as Water Services, Sewer Services, Information Technology, Facilities, and Customer Services. Financial expectations and limitations for CIP projects are provided by the GM and the CFO.

The program management consultants, under various Engineering Program Management Consultant (EPMC) contracts and DCCR's Program Consultants Organization (PCO), have been very effective in managing and delivering a structured approach to capital improvements. As specifically presented in Section 5, DC Clean Rivers, the integration of DC Water staff and PCO engineers are managing an extraordinary program that is complex with construction sites in various areas of DC performing under a stipulated schedule. Section 4.3, Blue Plains Advanced Wastewater Treatment Plant, is also evidence that Project Delivery is very effective at DC Water. EPMCs for linear and vertical assets are also evolving as DETS and Wastewater Engineering look to increase efficiencies between staff and consultant services.

2.4 GENERAL CONCLUSIONS REGARDING DC WATER'S STRUCTURE, ORGANIZATION, AND MANAGEMENT

A conclusion of this review is that considerable progress has been made by DC Water since the 2013 Assessment in meeting the needs and goals of the organization, stakeholders, regulators and the environment. During the intervening period, DC Water's management was stable, although retirements and staff turnover typical of this type of organization did occur at key positions. Transitions provided opportunities to reenergize staff in the mission and the core values of DC Water. The general tone during interviews, inspections and public meetings was positive with energy of dedication toward the mission of being a world-class water utility.

Overall, the independently operating agency is structured to be responsive in providing retail service to the District of Columbia and its residents, along with providing regional wholesale wastewater service. DC Water's governance and organization give voice and decision-making participation for the wholesale customers that are comprised of the surrounding Maryland and Northern Virginia counties and municipalities.

The previous assessment performed in 2013 reported on improvements and efficiencies in organizational structure and command-chain communications. This optimization has continued through the current assessment period with several reorganizations and optimizations to the managerial and reporting structures within the organization. The effect of these reorganizations is clear. There are new divisions of responsibilities in the engineering and operations of the facilities and assets of the utility. For example, a section of the DETS has been subdivided creating the aforementioned Wastewater Engineering.

This initiative is ongoing, but the intent communicated during interviews by the management team is that this new division will be defined as responsible for the engineering, planning, and management of DC Water's vertical wastewater infrastructure, treatment and pumping facilities. The existing DETS maintains the responsibility of similar functions for linear infrastructure, distribution and collections systems. A similar reorganization also occurred in the utility's operations, where a new Distribution and Conveyance Systems division was created for the operations and maintenance of the critical infrastructure that distributes water to the distribution system and conveys sewage from the collections system to treatment. Utility services (water and sewer) remain but are now more clearly focused on the distribution and collections systems. This results in engineering and operational units being aligned by linear and vertical assets delineation.

2.5 FINDINGS, KEY INITIATIVES & ACCOMPLISHMENTS

Section 2.5 presents findings of the independent review and also highlights some of DC Water's key initiatives and accomplishments.

2.5.1 CAPITAL PLANNING AND PROJECT IMPLEMENTATION

DC Water's capital planning process is comprehensive, aggressive, and encourages public participation. The CIP is in accord with the needs of an aging system operating in the context of increasingly more stringent environmental regulations. The CIP planning process allows for status monitoring and reassessment of priorities and funding needs on an annual basis and the flexibility to reprogram projects so that if new needs arise, DC Water can consider rescheduling non-mandated initiatives in order to accommodate more urgent needs. DC Water has relied on consultants, working closely with in-house staff, to ensure successful implementation of capital improvement projects.

2.5.2 PERMIT COMPLIANCE

Both Washington Aqueduct and DC Water continue to meet the various permit requirements established for the drinking water and wastewater systems. Conformance to NPDES permit conditions has been well documented and DC Water has been recognized by the wastewater profession for uninterrupted compliance of standards at Blue Plains

2.5.3 WATER SUPPLY/TREATMENT

The Washington Aqueduct Division continues to provide safe and dependable drinking water to the DC Metro Area. The advanced water treatment initiatives being undertaken address emerging contaminants that could threaten public water supplies.

2.5.4 TOTAL NITROGEN REMOVAL AND WET WEATHER PLAN

The successful modification of the Consent Decree has allowed DC Water to integrate the Combined Sewer Overflow -Long Term Control Plan (CSO-LTCP) with the enhanced nutrient removal advancements at Blue Plains to incorporate the Total Nitrogen/Wet Weather (TN/WW) Plan capabilities to address the stipulations within the modified Consent Decree.

2.5.5 COMBINED SEWER OVERFLOW – LONG TERM CONTROL PLAN

The DC Clean Rivers Project has accomplished the significant milestone of having the lower portion of the Anacostia River Tunnel facilities commissioned by March 23, 2018. The reduced nutrient loading and pollution abatement achieved is discussed in Section 5 of this report.

In 2017, DC Water let the largest project in its history for the Northeast Boundary Tunnel (NEBT) design/build effort. DCCR during the past five years has met the schedule requirements of the modified Consent Decree. ENR and biosolids improvements at Blue Plains are well coordinated with the TN/WW Plan as construction activities continue within the limited footprint of Blue Plains. It is the opinion of JMT that the capital improvement planning being managed by DC Clean Rivers Project exceeds typical approaches for consent decree programs as highlighted by the innovative and successful Green Initiatives that have eliminated the Rock Creek Tunnel and reduced the diameter of the future Potomac River Tunnel.

2.5.6 INVENTORY MANAGEMENT

A new inventory warehouse has been completed at Blue Plains. What's unique about this facility is that it is smaller than its predecessor. DC Water implemented a just-in-time (JIT) equipment replacement part program that uses a computerized system to track parts inventories and order the parts in time for scheduled replacement. Inventory management is also present at other DC Water facilities; decentralized inventory distributes specific equipment and repair parts to end users more efficiently than one warehouse remote to urban facilities.

2.5.7 ASSET MANAGEMENT

DC Water has prioritized establishing best management practices of its assets with the goal to maximize service life while minimizing costs and ensuring sustainability. Asset management includes: managing inventories of assets with supporting data that can be used to prioritize maintenance; used to prioritize capital projects; and assist long range decision making and financial planning. The program is established with a goal of creating and implementing a "world class" asset management program. Achieving a world-class asset management program means benchmarking DC Water's current asset management program with other cities known for their excellence in asset management.

DC Water launched initiatives to maximize the use of DC Water's current information technology (IT) asset tracking tools which include its Geographical Information Systems (GIS) and Maximo, a Computerized Maintenance Management System or CMMS (originally used for treatment facilities). The program has integrated stakeholders into the program and prioritized training to make the asset management program a success. This program was initially assessed in the 2013 assessment as a new initiative. At the time of the 2018 assessment, significant progress was identified in the program through interviews with management. A related system that was initially implemented during that time frame was the Engineering Document Management System. This $2.4M project was originally proposed as a centralized electronic source for all critical DC Water documents. It allows internal departments and consultants the ability to efficiently access data and information thereby increasing the base of knowledge available and saving time formerly spent searching for documentation.

2.5.8 CUSTOMER SERVICE

DC Water's Automated Meter Reading system (AMR) is capable of providing customers with twice-a-day readings. Along with the accuracy and dependability of monthly billing readings, this automated system is effective in identifying leakage. Overall customer service has been emphasized as DC Water has committed to being a leader and active participant in the community. This multi-year project will replace 90,000 meters by the end of FY 2018.

A significant accomplishment in improved customer service is the First Street Tunnel Design/Build project within the Bloomingdale community. The Bloomingdale Community has been on DC Water's priority list of areas requiring significant combined sewer capacity improvements for many years and was included in the upstream portions of the Combined Sewer Overflow - Long Term Control Plan (CSO-LTCP). 2012 storm events exacerbated the flooding conditions.

Clean Rivers initially had relief coming to this neighborhood in 2025 via the First Street Tunnel as part of the Northeast Boundary Tunnel portion of the Anacostia River Project. DC Water, the Mayor of the District of Columbia and residents collaborated on expediting the project. DC Water pushed up the procurement of the First Street Tunnel to 2013 and modified the tunnel design to include a temporary pump station that has allowed the tunnel to act as storm surge storage. A fast-tracked design-build project also provided up to 6 million gallons of combined sewage storage by converting McMillan WTP underground sand filtration basins into retention basins. Combined sewer flood relief for the neighborhood began in October 2016 - 9 years earlier than initially planned. Greater relief will be in 2022 which represents 3 years ahead of the CSO-LTCP schedule.

2.5.9 INFORMATION TECHNOLOGY

The Department of Information Technology has made considerable progress in both internal and external upgrades in providing informational services. Core infrastructure upgrades have been completed that improve virtual machine capabilities and provide redundancy and additional bandwidth. Total Management System (TEAMS-Maximo), a maintenance organization program, and Geographic Information Systems (GIS) have been integrated and deployed at DC Water, improving management of maintenance and repairs of equipment, buildings and grounds, and water/sewer infrastructure. Automated meter reading (AMR) systems have been upgraded to provide second generation Data Collector Units (DCUs), providing new user interfaces and valuable control and monitoring features. The Livelink Enterprise Document

Management System has been deployed, improving the availability and management of DC Water documents and files.

2.5.10 MAINTENANCE OF INFRASTRUCTURE

DC Water has established a 1% per annum replacement goal for aging infrastructure. This corresponds with the expected 100-year life of pipelines. This has required an increase in engineering design/inspection staff and funding for operations staff to complete repairs and replacement of water and sewer infrastructure. The Department of Engineering and Technical Services (DETS) has transferred water main replacement designs from design consultants to in-house engineering. The 1% replacement metric of ten miles per year is being achieved by in-house staff. DC Water improvements have an increased presence in neighborhoods where ratepayer funds are in evidence as water and sewer mains are being replaced in order to meet the 1% goal. The collection system improvement program has shifted from area-wide small gravity sewer replacement to the asset management driven plan of programmed replacement based on failure/inflow-infiltration/back-up criteria for specific pipe segments.

2.5.11 FIRE HYDRANT REPLACEMENT PROGRAM

As described in Section 3.6.5.3.2, Fire Hydrants, the replacement and repair of fire hydrants has been transferred from construction contract work force to in-house force account work performed by Water Utility Services. The Director of Water Utility Services reports that the goal of 500 replacements per year was achieved in 2017. Through a Memorandum of Understanding, DC Water is reimbursed by the District and the program does not impact ratepayers.

2.5.12 INFRASTRUCTURE LEAK INDEX

Since 2008, DC Water's sold/pumped ratio has fluctuated from 77% to a 2015 low of 70%. The internal audit of DC Water's infrastructure found an Infrastructure Leakage Index (ILI) Value of 7.49 for 2014, to a high ILI of 9.94 reported in 2015. The relatively high ILI without a corresponding gradual reduction through the years is not within EPA's Best Practices for Sustainable Water Conservation and Efficiency. The non-revenue water percentage has remained around 25%, which is typical of older, urban water systems. The ILI value reported for 2016 of 7.84 is typical of older distributions systems located in water rich areas in the US and puts DC Water's distribution system in the category of relatively efficient. The sold/pumped ratio between 2008 and 2017 is shown in **Exhibit 2-3**.

Exhibit 2-3: DC Water Sold/Pumped Ratio

DISTRICT OF COLUMBIA WATER AND SEWER AUTHORITY

EXHIBIT 18
WATER DELIVERED (PUMPED) AND BILLED (SOLD)
LAST TEN FISCAL YEARS

FISCAL YEAR	TREATED WATER DELIVERED (MG)	WATER BILLED (MG)	SOLD/PUMPED RATIO
2008	40,755	30,603	75.09%
2009	39,998	29,344	73.36%
2010	38,589	29,004	75.16%
2011	37,556	29,040	77.32%
2012	36,930	27,988	75.79%
2013	34,714	26,316	75.81%
2014	34,708	25,374	73.11%
2015	38,146	26,748	70.12%
2016	36,363	26,325	72.40%
2017	35,827	25,845	72.14%

Source: DC Water Department of Customer Service

2.5.13 BIOSOLIDS MANAGEMENT PLAN

The operational Walter F. Bailey Bioenergy Facility greatly reduces Blue Plains' energy footprint. This plan involved the construction of four Cambi thermal hydrolysis trains and digesters, new dewatering equipment and a combined heat and power plant. These projects were commissioned in late 2015 and improved the biosolids quality to Grade A while reducing solids volume and producing electricity. The reduced volume also reduces hauling costs. Grade A quality biosolids provide more certainty to land-application locations. Details for the BMP can be found in Section 4.3.6.1.4 Sludge Digestion Facilities. In summary, the digester gas is used by Pepco Energy Services (onsite) to produce steam. The Combined Heat and Power Facility has capacity to produce over 13 MW of gross electrical power at future solids throughput and the corresponding digester gas production. The reduction in weight and volume of the biosolids significantly reduces hauling costs. Class A Biosolids are marketed as Bloom®, a soil amendment, which recovers solids handling costs through product sales. These performance and savings metrics are closely monitored by DC Water.

2.5.14 DC WATER AWARDS

The following awards have been bestowed upon DC Water during the assessment period. These awards are a testament to the ongoing achievements and commitment to excellence of the DC Water team in their mission.

Award Title	Awarding Organization	Date(s) of Award
Distinguished Budget Presentation Award (Annual)	Government Finance Officers Association	FY2013 – FY2018 *****

Award Title	Awarding Organization	Date(s) of Award
Certificate of Achievement for Excellence in Financial Reporting	Government Finance Officers Association	FY2013 – FY2017 *
Project of the Year, 2016 - Blue Plains Tunnel	Engineering News Record	March 1, 2017
Water/Environment – Best Project: Blue Plains Tunnel	Engineering News Record - MidAtlantic	August 4, 2016
Award of Special Merit – Biosolids Main Process Train (CDM Smith)	International Federation of Consulting Engineers	October 2, 2017
ACEC Grand Award 2016 – Biosolids Management Program (CDM Smith)	American Council of Engineering Companies	April 19, 2016
Peak Platinum 5 Award – Blue Plains Wastewater Treatment Plant	National Association of Clean Water Agencies	2016
Peak Gold Award – Blue Plains Wastewater Treatment Plant	National Association of Clean Water Agencies	2015, 2014, 2013 *
Distinguished Service Award (Individual) – George S. Hawkins	National Association of Clean Water Agencies	2018
Environment Award (Individual) – Mark T. Kim	National Association of Clean Water Agencies	2017
Research and Technology Award – Mainstream Deammonification - A New "Blue-Print" for Cost Effective, Sustainable Nutrient Removal	National Association of Clean Water Agencies	2015
Operations & Environmental Performance Award – DC Water Ft. Reno Green Roof Project	National Association of Clean Water Agencies	2015
Public Information & Education Award – Building Public Support for Rate Increases Through Twitter	National Association of Clean Water Agencies	2016
Public Information & Education Award – Lady Bird as e-Ambassador	National Association of Clean Water Agencies	2016
Excellence in Management – Platinum Award	National Association of Clean Water Agencies	2014
Edward J. Clearly Award – Sudhir Murthy, PhD, P.E.	American Academy of Environmental Engineers and Scientists (AAofEE&S)	2017
Honorary Member – George Hawkins	AAofEE&S	2017
Juror's Citation in Conceptual/Un-built Architecture - HQO	American Institute of Architects, NoVA Chapter	2017
Juror's Citation in Conceptual/Un-built Architecture - HQO	American Institute of Architects, MD Chapter	2017
Utility of the Future	WEF/WERF/NACWA/EPA	2017
Excellence in Concrete Construction – First Street Tunnel	National Capital Chapter American Concrete Institute	2017

*** Exclusive of numerous awards received outside the period of this assessment**

2.5.15 DC WATER TECHNICAL PAPERS

Engineers at Blue Plains are prolific in publishing their research, with more than 1,000 abstracts among them in just the last 10 years. These technical papers have been presented at wastewater conferences across the country touting Blue Plains' implementation of advanced wastewater treatment processes.

2.5.16 DC WATER PATENTS

Over the past 5-years, DC Water has fostered a spirit of technological innovation. This is evident in patents registered to the organization over this period. No less than eight patents, primarily for innovation in wastewater treatment have been granted to DC Water since 2013. These patents are indicative of a high performing organization that is attracting and furnishing some of the best engineering talent, putting them to work solving modern water challenges.

2.6 RECOMMENDATIONS

2.6.1 ASSET MANAGEMENT

Great strides have been accomplished using IBM Maximo Asset Management for both linear and vertical assets. Recommended actions:

- It is recommended that DC Water continue to pursue 'front-end' user interface upgrades to its EAM/CMMS software, Maximo, to increase ease of use and for staff, particularly in mobile applications for linear infrastructure. Some cited Maximo as designed primarily for facility-oriented applications such as, structural, mechanical, and control systems.
- DC Water should take advantage of the Department of Sewer Services' production metrics regarding catch basin maintenance. DSS has pursued performance metrics showing deep catch basins and environmentally designed catch basins can be maintained more efficiently and environmentally effective by mechanical equipment (clamshells) vs. the more common industry use of vacuum and flushing equipment.

2.6.2 DESIGN ENGINEERING & PROGRAM MANAGEMENT

As the Facilities Plans mature and the Capital Improvements driven by regulation have been implemented, continued consideration should be given to the ratio between in-house engineering expertise and consultant services. Current conversions to in-house design and force account work indicate savings and successful project completion can be obtained by DC Water employees.

2.6.3 UNACCOUNTABLE WATER

The three-year trend, 2015-2017, of water sold/pumped ratio below 75% is considered cautionary by the American Water Works Association. DC Water should continue to identify water inefficiencies to target those requiring corrective measures. Large metering is often a vector where losses can be eliminated, and revenues increased.

2.6.4 DRINKING WATER MANAGEMENT

The 2013 Assessment recommended:

> ***"DC Water could explore increasing its role in potable water treatment. Water supply, water treatment and water distribution as a monolithic arrangement under a single management and financing structure has proven to be effective throughout the United States. JMT has not studied this in great detail; however, there may be management and cost efficiencies that could be achieved to benefit both DC Water and its rate payers. In addition, DC Water could have better control to expand its water customer base and to be responsible for the quality of the potable water it produces."***

In 2018, the uncertainty of the continued federal ownership of the Washington Aqueduct assets reinforces the consideration of an accomplished organization such as DC Water to be the manager into perpetuity of the Washington D.C. Metro area's water treatment system. Being the agency responsible for regional wastewater treatment at the world's largest advanced wastewater treatment plant with a very successful water quality compliance record, DC Water has the professional resources to meet the drinking water needs for the DC Metro area. The success of Clean Rivers as a large public works tunneling organization addresses the long-term need of the aging aqueduct and appurtenances starting at the Great Falls intake structure.

SECTION 3 DRINKING WATER SYSTEMS

3.1 OVERVIEW

DC Water provides drinking water to the residents, businesses and institutional facilities within the District of Columbia. DC Water is classified as a consecutive system. Consecutive systems obtain finished or potable water from another water purveyor. DC Water conveys and distributes potable water purchased from the Washington Aqueduct Division (the Aqueduct), which is chartered to treat Potomac River water for the District and parts of Northern Virginia. This section of the engineering assessment addresses the investigation of the Aqueduct in addition to DC Water's engineering and utility services that are pertinent to the drinking water system.

In assessing the drinking water system, the components were reviewed: water supply, treatment facilities, transmission, pumping stations, storage facilities, and the distribution system. Facilities owned and operated by the Aqueduct are presented separately from those owned and operated by DC Water. Generally, the Aqueduct owns and operates the raw water intakes, conduits and raw water pumping facilities; treatment facilities; and finished water reservoirs. DC Water owns and operates transmission conduits, storage facilities, pumping station facilities and the water distribution system. **Exhibit 3-1** outlines the Aqueduct's service area and major assets.

Exhibit 3-1: Washington Aqueduct Service Area and Major Facilities

3.2 THE WASHINGTON AQUEDUCT

3.2.1 STRUCTURE, ORGANIZATION AND MANAGEMENT PROCESSES

A division of the Baltimore District, U.S. Army Corps of Engineers (the Corps), Washington Aqueduct (the Aqueduct) is a federally-owned and operated public water supply agency that produces an average of 160 million gallons of drinking water per day from its two treatment plants in the District of Columbia. Daily, the Aqueduct serves water to approximately 1 million people living, working, or visiting the District of Columbia; Arlington County, Virginia; the City of Falls Church, and its service area in Fairfax County, Virginia. In January 2014, Fairfax Water, the largest water utility in Virginia, assumed ownership and operation of the drinking water supply for the City of Falls Church and its service area. In doing so, Fairfax Water became a wholesale customer of the Aqueduct.

The Corps designed, built, and, in 1859, began operating the Aqueduct. Since then, the Aqueduct has substantially expanded and improved the capacity and function of the original 19th century infrastructure, which supplied raw river water to a sparsely populated District of Columbia service area. It is now providing safe drinking water to a much larger and more populous service area employing modern technology and facilities.

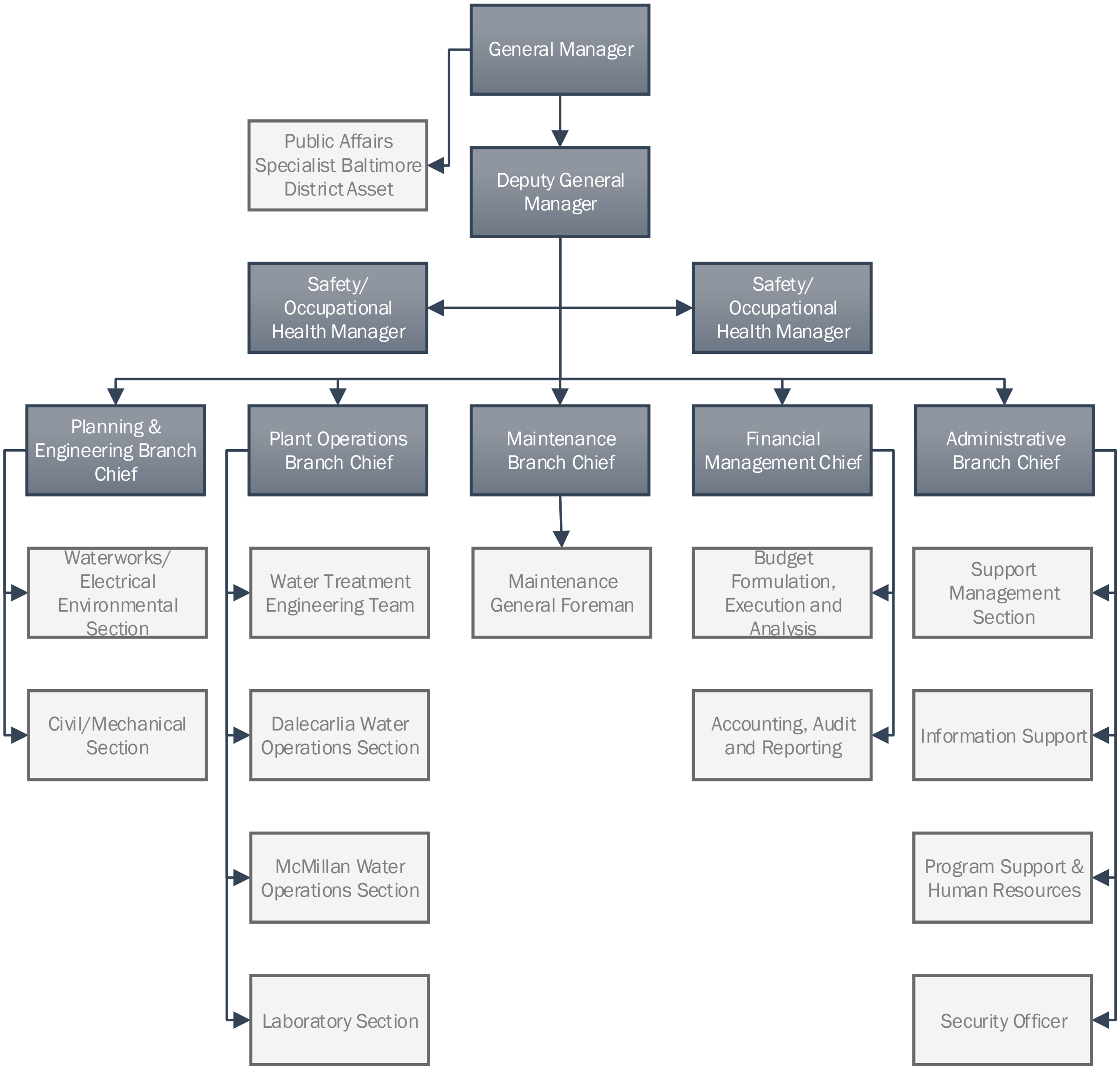
The Aqueduct is proud of its tradition of providing a reliable and safe water supply. In its treatment brochure, the Aqueduct quotes George Washington from 1798:

"The water of the Potomac may, and will be brought from above the Great Falls into the Federal City, which would, in future, afford an ample supply of this object."

The Aqueduct continues to supply an ample amount of water operating from clearly defined agreements and divisions of responsibility.

The executive management of the Aqueduct is comprised of a General Manager who is supported by four Branch Chiefs and a Financial Management Officer. The various branches of the Aqueduct provide for the streamlining of the functional requirements for operating and managing the water utility. Washington Aqueduct's organizational chart is presented as **Exhibit 3-2** below:

Exhibit 3-2: Washington Aqueduct Division Organizational Chart



The Aqueduct has 179 authorized positions for FY 2017, equal to its 2013 staffing level, and a reduction from the 2002 authorized level of 194 positions. The Aqueduct has outsourced some of its staffing requirements for support activities. Janitorial, grounds keeping, security, and certain facilities maintenance activities are currently performed by external providers under contract to the Aqueduct. In addition, the staffed position level is below the authorized level as the Aqueduct is in the process of hiring replacements for its aging workforce as long-term employees retire. This increase in retirements is being experienced by utilities throughout the United States. The Aqueduct continues performing its mission effectively and places a high priority on securing qualified personnel.

As the Aqueduct has practiced for many years, all capital improvements are funded on a pay-as-you-go basis with pro-rata contributions from its three municipal customers. Each fiscal year, the Aqueduct submits a proposed capital program to these wholesale customers (constituting the Wholesale Customer Board) for approval and inclusion in their respective budgets. The Aqueduct enjoys some latitude to request reprogramming after approval by its customers.

Before advertising any contract, and under federal regulations (applicable to the Aqueduct as an agency under the US Army), the customers deposit the required contribution with the US Treasury.

3.2.2 GENERAL CONCLUSIONS AS TO THE AQUEDUCT'S STRUCTURE, ORGANIZATION, AND MANAGEMENT

The Aqueduct operates in a well-organized manner with relatively minor changes in managerial staff even as baby-boomers retire throughout the industry. In June of 2013, DC Water selected Veolia to conduct an independent and comprehensive study of the Aqueduct. Veolia is a large global organization, which, in part, provides water management solutions. The goal of the study was to identify opportunities to foster the continued development of a world class operation at the Aqueduct with a focus on operational efficiency, quality, and reliability.

From July through October 2013, Veolia's team worked alongside Washington Aqueduct management and employees to identify opportunities to make improvements. This effort took as its slogan: ***"Achieving Excellence, Source to Tap"***, which fostered partnering between consultants and staff. Several very useful ideas were put forth. From these, a second phase of the consultant effort was focused on improvements in maintenance management using a computer-based maintenance management system. The Aqueduct committed itself to incorporating a maintenance management system into its activities. The results indicate a continuous improvement practice is in place.

As part of this inspection, JMT reviewed parts of Veolia's *"Independent Comprehensive Review of the Washington Aqueduct".* JMT's review of the documentation supports the validity of the cooperative effort between Veolia and the Aqueduct in identifying chemical usage and maintenance practices as areas of potential savings from planning and optimization efforts. It is also worth mention that Veolia recognized the Aqueduct's ratio of full-time employees per million gallons per day (mgd) of treated water was aligned with benchmarked utilities.

Compliance reports are submitted regularly to the offices of EPA Region 3, in Philadelphia, PA. Permitting at the Aqueduct is different from other water agencies, as there is no formal permitting process for this unique federally-owned utility. Changes to the system are submitted to EPA Region 3 as written explanations.

The Aqueduct maintains and upgrades its infrastructure, in part to comply with regulations, through its Capital Improvements Plan (CIP). The 10-year 2018 to 2027 CIP projects $165,270,000 in capital improvements. A high-level summary of the Aqueduct's CIP is presented in **Exhibit 3-3.**

Exhibit 3-3: Washington Aqueduct Capital Improvements Plan FY 2018-2027

Capital Improvements Plan Item	FY2018 - FY2027
1A: Meet Legal Obligations	-
1B: Required to Provide Safe Water in a Safe	$52,420,000
2: Required to Improve Process & Public	$3,100,000
3A: Required to Provide Reliable Water Service	$86,750,000
3B: Required to Sustain Infrastructure	$17,000,000
Emerging Project Fund	$6,000,000
Total	**$165,270,000**

The CIP addresses infrastructure needs under a three-tiered priority ranking. Improvements and upgrades to the raw water transmission system, the Dalecarlia and McMillan water treatment plants and pumping stations, along with further hardening of various sites, constitute the bulk of the CIP. DC Water's approximate 73% prorated contribution to these projects is projected by Washington Aqueduct at approximately $120.6 million. In 2016 the Board approved a two-year trial of a category called "emerging project fund" and funded it for $3,000,000. Washington Aqueduct managers will notify the board of the intent to use that fund and if no objection is raised the project(s) would be approved.

Under the tiered priority system, the following major maintenance construction projects were accomplished between 2013 and 2017:

Exhibit 3-4: Washington Aqueduct Major Maintenance/Upgrades - 2013 to 2017

Project Name	Cost
30 MG Clearwell Gatehouse Rebuild	$0.7M
Little Falls Pumping Station Motor Control Upgrades	$4.3M
Dalecarlia Power Distribution Upgrades	$1.3M
First High Reservoir Improvements	$9.9M
Dalecarlia Pumping Station Building Renovation	$1.3M
McMillan Caustic Soda Containment Area Sealing	$0.9M
McMillan Chemical Building Renovations	$1.1M
Sample Line Improvements	$2.6M
South Connection 72" Butterfly Valve Replacement	$0.3M
EASA Building Clean-up and Stabilization	$1.6M
20" Washwater Line Emergency Repair	$0.3M
Dalecarlia Box Conduit Joint Repairs	$0.03M
Dalecarlia Gasoline Tank Manway Repair	$0.04M
Dalecarlia Pump Motor Circuit Breaker Replacement	$1.7M
McMillan Power Protection System Upgrades	$2.3M
RPF Thickener Number 2 Feedwell Replacement	$0.2M
West Filter backwash Valve Installation	$0.3M
Third High Reservoir and McMillan North Clearwell Cleaning	$2.2M
McMillan North Clearwell Influent Gate Actuator Replacement	$0.1M
East Shaft Pumping Station Rehabilitation	$5.3M

Project Name	Cost
McMillan Reservoir Cove Dredging	$1.3M
Washington Aqueduct Dredging and Disposal Contract – 2016	$2.6M
Chemical Building Roadway Improvements	$1.3M
Admin and Maintenance Building Boiler Control Replacement	$0.4M
Maintenance Building Carpenter Shop Wall Bracing	$0.06M
Low Lift Pumping Station Water Main Repairs	$0.2M

The following construction projects began in 2016 or 2017 and are ongoing:

Exhibit 3-5: Washington Aqueduct Major Maintenance/Upgrades – Ongoing (2016 – Present)

Project Name	Cost
Georgetown Reservoir Building Improvements	$5.0M
East Shaft Pumping Station Rehabilitation	$5.3M
Fire Protection System Improvements	$3.8M
Washington Aqueduct Dredging and Disposal Contract – 2016	$2.6M
McMillan Transformer/Switchgear Building Renovation	$2.5M
Dalecarlia Basin Collector Modifications	$1.5M
Arc Flash Safety Improvements	$0.3M
Dalecarlia Chemical Building Electrical Upgrades	$6.8M

The CIP expenditures do not include the cost of extensive treatment changes that have been evaluated under the scope of the Advanced Treatment Project. This project has been supported by the Wholesale Customers who have approved a piloting plan to test the efficacy of the use of ozone, biologically active filters, and ultraviolet disinfection in some combination as part of the Advanced Treatment Project. At the time of this report, the Wholesale Customer Board has not reached a decision on the level of funding or the timing of the introduction of the approved processes. This is an ongoing initiative to improve water treatment capabilities. As developed, the cost for introducing all the processes at both Aqueduct treatment plants would be in the range of $400,000,000 in 2016 dollars.

The upgrade/replacement activity between 2013 and 2017, along with continuing projects, represents the level of effort being undertaken to ensure the Aqueduct accomplishes its mission of providing safe drinking water to its metropolitan Washington, D.C. service area.

3.3 WATER SUPPLY MANAGEMENT AND COORDINATION

The Potomac River is the sole source of raw water for the Aqueduct's two drinking water treatment plants; Dalecarlia and McMillan. In addition to Washington Aqueduct's demand on the river supply, the Potomac River is the main source of water for the region; the river also supplies Fairfax Water's Corbalis Water Treatment Plant (WTP) and the Washington Suburban Sanitation Commission's (WSSC) Potomac WTP. The region is very cognizant of the sensitivity to drought and the threat of contamination inherent to the river supply.

The Interstate Commission on the Potomac River Basin (IPCRB) was created with an interstate compact established by Congress in 1940 to help the Potomac basin states and the federal government enhance, protect, and conserve the water and associated land resources of the Potomac River basin through regional and interstate cooperation. The IPCRB jurisdictions are represented by appointed Commissioners from Maryland, Pennsylvania, Virginia, West Virginia, the District of Columbia, and the federal government.

The threat of contamination to a river as a sole source of drinking water occurred on the Potomac River in November of 2016. The IPCRB reported on an oil spill that created sheen on the surface of the river. The IPCRB reports are the references used by JMT in this report. The various water intakes of the aforementioned plants were reported to be protected by protective booms and water intake operational methods. The IPCRB publicly reported at the time of the occurrence that, ***"All drinking water facilities are operating, safe, and protected."***

In 2017 the ICRPB Commissioners undertook a study to determine if there might be advantages to proposing specific changes to the current Low Flow Allocation Agreement (LFA), which is an interstate agreement. The commissioners represent all of the entities that are signatories to the agreement. The various facilities and agreements pertaining to the Potomac River as a water supply were presented in the 2013 JMT report and are unchanged during this review period. The specific concerns within the LFA include the role of the moderator who is defined as the individual to settle disputes concerning allocations and whether or not the current agreement is protective of the river with respect to the amount of water to be allowed to flow over Little Falls Dam in times of drought. These issues will be further addressed in 2018. The importance of evaluating the extent to which the resulting changes, if any, affect the resilience of the region's water supply stored in the Jennings Randolph, Savage and Little Seneca Reservoirs has been recognized. This evaluation might be affected if an additional off-stream reservoir was constructed. Specifically, the acquisition of the Travilah Quarry has been studied by the IPCRB with the consulting engineer's report completed in 2015. Developing the quarry as a regional resource for source water supply during drought conditions also allows for an off-river water supply immune to river contamination events.

The JMT review of research, studies and reports for this 2018 Assessment and the previous 2013 Report provides reassurance that the river continues to provide a sufficient supply of good quality raw water to meet the needs of Washington Aqueduct and the other water utilities in the region. Interviews at Washington Aqueduct reinforced confidence in the planning and emergency operational plans in place during low flows and the future protective strategies for contaminating events.

3.4 TREATMENT PROCESSES AND RELATED FACILITIES

3.4.1 RAW WATER SUPPLY

Raw water from the Potomac River flows by gravity from the Great Falls intake structure, upstream of the dam, via the aqueduct/conduit to a forebay adjacent, and prior, to the Dalecarlia Reservoir. The original facilities at the Great Falls Dam and Intake were built in 1869, with major renovations undertaken in 1969. The Great Falls Dam and Intake can supply a total of up to 217 mgd to the Dalecarlia Reservoir.
In addition to the gravity flow from Great Falls, a second intake is at Little Falls, from where water is pumped directly to the Dalecarlia Reservoir. The Little Falls Pumping Station and Intake were built in 1958 and have the capacity to deliver 525 mgd of water to the Dalecarlia Reservoir.

3.4.2 PRETREATMENT STORAGE

The Dalecarlia Reservoir is a 238 million gallon earthen basin that serves primarily as a pretreatment reservoir for both the Dalecarlia and McMillan water treatment plants. Retention of raw water in this reservoir allows some of the suspended solids to separate from the aqueous portion of the untreated water. Sediments retained in the Dalecarlia Reservoir are removed via a dredging system and conveyed to the Basin Recovery Facility. The Dalecarlia Reservoir transmits water by gravity feed to both the Dalecarlia Water Treatment Plant (Dalecarlia sedimentation basins) and the Georgetown Reservoir.

As previously presented in the CIP improvements, presented in exhibits 3-4 and 3-5, pretreatment storage improvements are underway to improve the removal of residuals from the forebay and reservoir at Dalecarlia.

3.4.3 WATER TREATMENT

The Dalecarlia Water Treatment Plant is the larger of the Aqueduct's two water treatment plants. The original Dalecarlia facility was built in 1928. The plant capacity was increased in the 1950s by the addition of two additional sedimentation basins, a 30-mg clear well, a 577-mgd finished water pumping station and additional filters. A new chemical building and an additional filter building were completed in 1964. The plant currently has a capacity of 164 mgd, based on filtration rates of two gallons per minute per square foot (gpm/sf), and a maximum capacity of 264 mgd. Water from the Georgetown Reservoir (sedimentation basins) is delivered to the McMillan Water Treatment Plant via the Washington City Tunnel. Originally constructed in 1905 as a slow sand filter plant, the McMillan WTP was replaced in 1985 and is now a rapid sand filtration plant. This plant has a design capacity of 120 mg, based on 4 gpm/sf filter design rate, with a maximum capacity of 180 mgd.

The Basin Waste Recovery/Residuals Disposal facility was completed during the 2013 Independent Engineer's Report. JMT inspected and investigated the first five years of operation for this 2018 report. The facility is well maintained and operating in a manner based on continuous improvements as the processing of the unique characteristics of the sediment material is optimized.

Both Dalecarlia and McMillan plants employ the following treatment technologies:

Screening - On its way from the river to the Dalecarlia and McMillan treatment plants, raw water passes through a series of screens designed to remove debris such as twigs and leaves.

Pre-sedimentation - While the water moves slowly through Dalecarlia Reservoir, much of the sand and silt settles to the bottom.

Coagulation - A coagulant, aluminum sulfate (alum), is added to the water as it flows to sedimentation basins. Coagulants aid in the removal of suspended particles by causing them to consolidate and settle. Alum contains positively charged atoms called ions which attract the negatively charged particles suspended in water causing them to gather into clumps of particles heavy enough to settle.

Flocculation - The water is gently stirred with large paddles to distribute the coagulant; this causes particles to combine and grow large and heavy enough to settle. This process takes approximately 25 minutes.

Sedimentation - The water flows into quiet sedimentation basins where the flocculated particles settle to the bottom. After about four hours, approximately 85 percent of the suspended material settles.

Filtration - Water at the top of the basins flows to large gravity filters, where the water flows down through filter media consisting of layers of small pieces of hard coal (anthracite), sand, and gravel placed in the bottom of deep, concrete-walled boxes. Filtered water passes through to a collecting system underneath.

Disinfection - Chlorine is added with precision equipment to kill pathogenic microscopic life such as bacteria or viruses. Ammonia can be then added. The chlorine and ammonia combine to form chloramine compounds. The concentration of chloramines in the water is closely monitored from the time it is added at the treatment plants to points near the farthest points of the distribution systems.

Corrosion Control - In addition, orthophosphate is added to control corrosion in pipes, service lines, and household plumbing throughout the distribution system. This will be discussed further in the water distribution section.

Other Treatments - Fluoride, in the form of hydrofluorosilic acid, is added to reduce tooth decay, a common practice in public drinking water systems. Powdered activated carbon is occasionally used for taste and odor control, which is a safeguard against raw water quality fluctuations associated with a river supply.

3.4.4 WASHINGTON AQUEDUCT CONDITION ASSESSMENT

3.4.4.1 DALECARLIA FACILITIES

On November 30, 2017, JMT met with Washington Aqueduct management and conducted a site investigation of the facilities with emphasis on the operations and maintenance of the five-year old Residuals Management Facilities. Operational modifications evidenced a continued effort in quality operational improvements. The Dalecarlia campus exhibited exceptional housekeeping and operational performance within a secure site.

3.4.4.2 MCMILLAN WATER TREATMENT PLANT

On February 21, 2018, JMT met with the plant manager at the McMillan Water Treatment Plant and performed a site inspection and a review of the ongoing capital improvements. The plant is well managed and maintained with good housekeeping. The plant operates within EPA regulations; JMT's review included the procedures for backwashing the water filters and the subsequent discharge of backwash water with the particulate matter into the designated area within the McMillan reservoir.

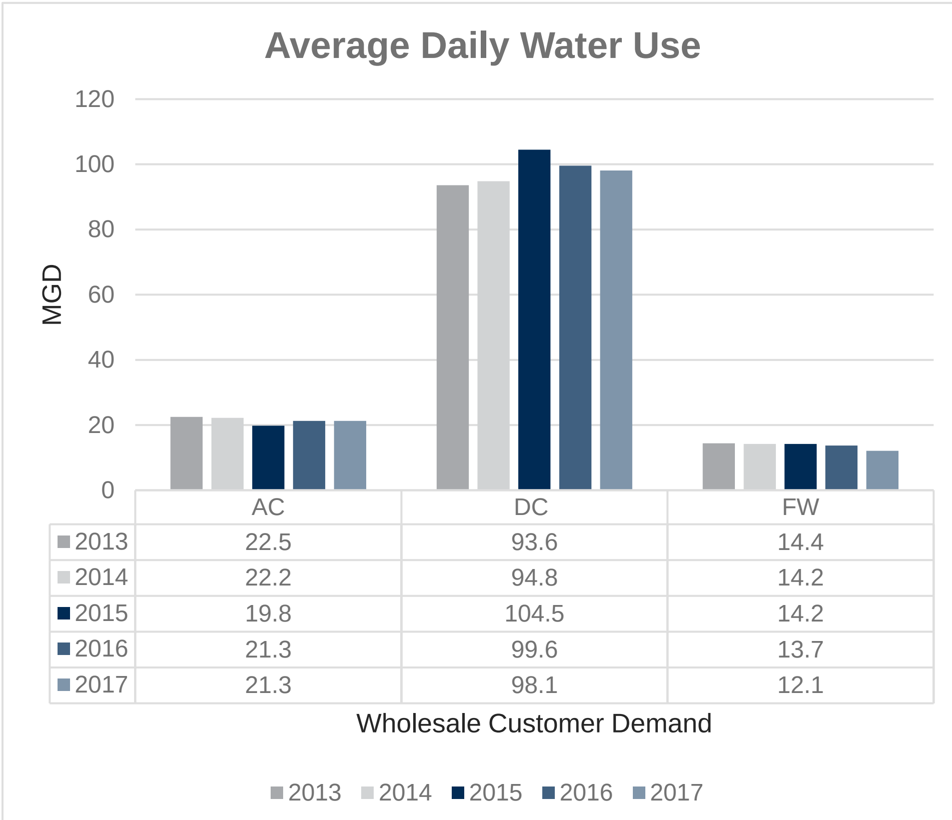
3.5 WATER DEMAND HISTORY

The Aqueduct's systems combine for a raw water capacity of 700 mgd and the combined treatment capacity of the Dalecarlia and McMillan water treatment plants is 350 mgd. In FY 2017, the Aqueduct produced an average of 131.5 million gallons per day, which represents a continuing reduction in water demand. The reduction represents a 2% decrease from FY 2016. The 2013 JMT report reported a decrease from 155.3 mgd to 139 mgd over a five-year period. The transfer of the City of Fall Church system to Fairfax Water skews comparative FY2016 and FY 2017 demand totals as the combined operations within Fairfax Water may have changed service areas to some extent between water supplies.

In FY 2017, 98.1 million gallons of water were provided to the District (daily average) as compared to 99.6 million gallons in FY 2016. Both FY 2016 and FY2017 wholesale purchases exceeded the 93.6 million gallons purchased daily in FY 2013. **Exhibit 3-7** below summarizes water demand from FY 2013 through FY 2017, where DC represents DC Water, AC represents Arlington County, and FW represents Fairfax Water. The abnormal peak of 104.5 mgd daily average in FY 2015 is attributable to Arlington County's reconfiguration of the County's transmission system that created an altered hydraulic gradient. This caused a larger portion of the federal water demand, i.e. Pentagon and Ronald Reagan Washington National Airport to be routed through DC Water meters vs. the normal conveyance within Arlington County. Specifically, the potable water delivered to the federal facilities was diverted from the Chain Bridge crossing to the DC Water controlled Key Bridge crossing.

Additional information was gained from an interview with DC Water's Assistant General Manager, Customer Care& Operations concerning a significant upgrade to the Key Bridge/federal wholesale metering. The upgraded metering now allows for more reliable measurement, enhanced by the ability to remotely monitor and report the flow through the metering facility.

Exhibit 3-7: Summary Water Demands 2013 - 2017



	AC	DC	FW
2013	22.5	93.6	14.4
2014	22.2	94.8	14.2
2015	19.8	104.5	14.2
2016	21.3	99.6	13.7
2017	21.3	98.1	12.1

3.6 WATER SYSTEM SERVICE AREA

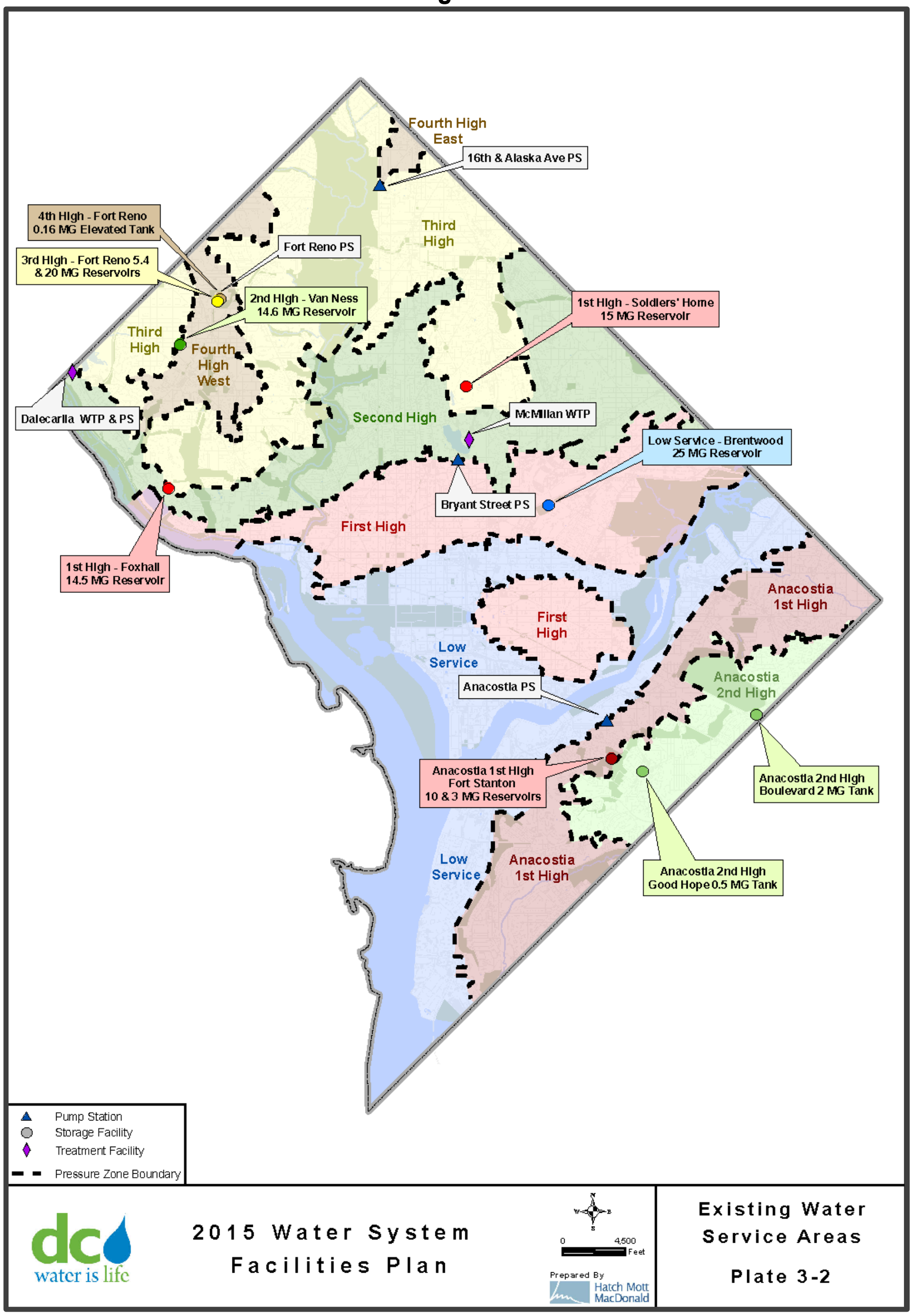
Potable drinking water is delivered to DC Water from the two Washington Aqueduct water treatment plants. The distribution system is a combination of DC Water-owned and controlled assets and particular facilities owned by the Aqueduct. DC Water serves its retail customers through a distribution network consisting of underground reservoirs, elevated tanks, pipes, valves and various system appurtenances. Both DC Water and the Aqueduct own components of the distribution network.

DC Water's distribution system consists of approximately 1,300 miles of pipe with over 36,000 valves for controlling the flow. An important function of the system is to provide fire protection for the District of Columbia. The system includes approximately 9,500 public fire hydrants. DC Water maintains 8 storage tanks – 3 elevated tanks and 5 ground reservoirs. In addition, there are five water pumping stations with the largest being the Bryant Street Station with a capacity of 194 mgd.

3.6.1 SYSTEM OVERVIEW

The water distribution system has been configured to provide a service pressure of approximately 50 pounds per square inch (psi). To maintain suitable pressures for domestic use, the water distribution system is divided into seven pressure zones following topographical changes. The current service areas, or zones, are shown in **Exhibit 3-8**.

Exhibit 3-8: Existing Water Service Areas



These service areas are served by a system consisting of five pumping stations, eleven reservoirs and elevated tanks. One of the pumping stations is operated by the Washington Aqueduct Division as are three of the reservoirs.

Low Service Area corresponds to places with ground elevations between 0 and 70 feet and includes areas along the Potomac and Anacostia Rivers. This area is served by the Dalecarlia Pumping Station (operated by the Washington Aqueduct Division), and the Bryant Street Pumping Station. The pressure in the Low Service Area is controlled by the water level in Brentwood Reservoir.

First High Service Area is located on the west side of the Anacostia River where the ground elevations range between approximately 70 and 140 feet above sea level. This area is served by the Dalecarlia and Bryant Street pumping stations. The pressure in the First High Service Area is controlled by the water levels in the Fox Hall Reservoir and the Soldier’s Home Reservoir. The Fox Hall Reservoir is owned by the Washington Aqueduct Division, while the Soldier’s Home Reservoir is owned by DC Water.

Anacostia First High Service Area serves communities located southeast of the Anacostia River and having ground elevations between 70 and 170 feet. Water to this zone is supplied by the Anacostia Pumping Station. The pressure in this area is controlled by the water level in Fort Stanton Reservoirs No.1 and No.2.

Second High Service Area serves the area west of the Anacostia River between Rock Creek Park and Eastern Avenue with ground elevations between 140 and 210 feet. As with the First High Service Area, this area is served by the Dalecarlia and Bryant Street pumping stations. The pressure in the Second High Service Area is governed by the water level in the Van Ness Reservoir. The Van Ness Reservoir is owned and operated by Washington Aqueduct.

Anacostia Second High Service Area serves the area located southeast of the Anacostia River along Southern Avenue and having ground elevations above 170 feet. This area is served by the Anacostia Pumping Station. The pressure in this area is controlled by the water level in the Good Hope Road Elevated Tank and the Boulevard Elevated Tank. The St. Elizabeth’s Elevated Water Tank will control a new Anacostia High Service Area in the southern portion of the Anacostia First High Area. This service area is scheduled to be on line in spring, 2018.

Third High Service Area is located west of the Anacostia River with ground elevations between 210 and 350 feet above sea level. This area is served by the Dalecarlia and Bryant Street pumping stations. The water supply to the Third High Service Area comes from both the Dalecarlia Pumping Station and the Bryant Street Pumping Station. The service pressure is governed by the water level in the two Fort Reno reservoirs, Fort Reno Reservoir No. 1 and Fort Reno Reservoir No.2. The Fort Reno Reservoir #2 is owned and operated by the Washington Aqueduct Division.

Fourth High Service Area serves the area west of the Anacostia River, separated by Rock Creek Park, bounded by Eastern and Western Avenues, and with ground elevation above 350 feet. The Fourth High Service Area is further subdivided into an eastern portion and a western portion. The Fort Reno Pumping Station supplies the western portion. The Fort Reno Pumping Station pumps from water that is supplied from the Third High Service Area. The western system pressure has been controlled by the water level in the 0.16 MG Fort Reno Elevated Tank. Within this review period, the elevated tank has been brought off-line as the renovated pumping station can control the water level with variable speed pumps. The system pressure for the eastern portion of the Fourth High Service Area is provided by the 16th and Alaska Pumping Station.

The DC Water distribution system is configured in the same pressure areas as reported in the 2008 Assessment. **Exhibit 3-9** summarizes the zone configuration.

Exhibit 3-9: Water Service Area Pressure Zones

Pressure Zone	Ground Elevation	Maximum Static Hydraulic Grade Line
Low	0 to 70 feet	172 feet
First High	70 to 140 feet	250 feet
Anacostia First High	70 to 170 feet	258 feet
Second High	140 to 210 feet	335 feet
Anacostia Second High	Above 170 feet	382 feet
Third High	210 to 350 feet	424 feet
Fourth High	Above 350 feet	510 feet

3.6.2 2015 WATER SYSTEM FACILITIES PLAN

DC Water's 2015 update to the Facilities Plan (originally developed in 2000) is the planning document presently guiding the elements of the Capital Improvement Program. The document presents a strategy for DC Water to continue providing safe, adequate, and reliable service to its customers. The 2015 Facilities Plan Update:

- Presents population and demand projections through the year 2035.
- Reviews current water quality data and proposed water quality regulations.
- Evaluates pumping, storage, transmission, and distribution infrastructure systems and identifies investment needs to meet system demands and water quality requirements over the next 20 years to continue providing a reliable supply at adequate flows and pressures.
- Presents a prioritized Capital Improvement Program (CIP) for pumping, storage, transmission, and distribution.
- Identifies other recommendations including continuous improvement in Asset Management

The 2015 Facilities Plan Update is comprehensive and current. Based on the accomplishments of DC Water in implementing improvements presented in the previous 2009 Water Facilities Plan Update, DC Water ratepayers can be assured that the recommendations and schedules of the Facility Plan are being implemented.

3.6.3 PUMPING STATIONS

Exhibit 3-10 summarizes the five pumping stations serving the pressure zones. One of these stations, the Dalecarlia Pumping Station, is owned and operated by the Aqueduct. As part of the regional water system serving the D.C. area, DC Water utilizes the pumping capabilities of the Aqueduct. Beyond the pressure levels served by the Dalecarlia pumping facility, DC Water maintains four pumping stations that draw water from lower pressure zones, pressurizing the water delivered to higher zones.

Exhibit 3-10: Drinking Water Pumping Facilities

Facility	Date in Service	Service Area	Capacity
Dalecarlia Pumping Station (Aqueduct operated)	1928	Low, First High, and Third High	310 mgd
Bryant Street Pumping Station	1905	Low, First High, Second High, and Third High	194 mgd
Fort Reno Pumping Station	1977	From Third High to Fourth High	15.7 mgd
16th & Alaska Pumping Station	1993	From Third High to Fourth High	3.5 mgd
Anacostia Pumping Station	2008	From Low to Anacostia First and Second High	82.8 mgd

3.6.3.1 WASHINGTON AQUEDUCT PUMPING CAPABILITIES

3.6.3.1.1 DALECARLIA PUMPING STATION

As part of the Dalecarlia Water Treatment Plant, this station was built in 1928. The pumping station has a firm capacity of 310 mgd and provides service to Low, First High, Second High, and the Third High Service Areas. In addition to serving these zones within the District of Columbia, this station also provides service to Arlington County, and a portion of the Fairfax Water service area (formerly the service area of the City of Falls Church).

3.6.3.2 DC WATER PUMPING STATIONS

3.6.3.2.1 BRYANT STREET PUMPING STATION

The Bryant Street Pumping Station was built in 1905 and pumps water to the Low, First High, Second High, and Third High Services Areas. At a capacity of 194 mgd, it is DC Water’s largest water pumping station. Major renovations of the Bryant Street Pumping Station had been completed prior to this reporting period. As the central pumping operations and control facility, the Bryant Street Pumping Station is the nerve center of water distribution for DC Water. The renovations have made the station and its operating center both effective and efficient in the reliable delivery of drinking water.

Condition Assessment

DC Water has completed numerous capital projects in the previous twenty years for this historical facility. **Exhibit 3-11** is a list of recent capital projects completed or programmed during this review period, these upgrades continue the operational efficacy of the facility, which supplies water to all pressure zones, is the central control facility for the water system, housing many DC Water offices and functions.

Exhibit 3-11: Bryant Street Pumping Station CIP Projects

Project ID	Project Title	Cost	Timeline
DU	Water System Laboratory Facilities – Provides laboratory facilities for the Water Quality Division at the Bryant Street Pumping Station	$0.6M	Completed
FD	Water Facilities Security System Upgrades – Provides security system upgrades to water storage facilities	$2.0M	Completion Dec 2019
FH	Discharge Piping Bryant Street Pumping Station – Provides replacement for highly corroded discharge pipes	$13.4M	Completion Jun 2018
HI	Bryant Street Pump Station Phase II	$5.9M	Completion 2024
HV	Bryant Street Pump Station Spill Header Flow Control – Provides replacement of manual PRVs with actuated PRVs	$5.9M	Completion FY 2024
JB	Bryant Street Pumping Station Improvements – Phase II – Provides modifications and structural reinforcement of warehouse and shop buildings on Bryant Street Pumping Station Site	$11.7M	Completion Aug 2018
M6	Rehabilitation of Bryant Street Pumping Station – Rehabilitates and upgrades pumping station	$61.1M	Completed FY 2016

Interviews conducted with engineering and operation staff, along with several field visits and site inspections at the station, indicate the station is in excellent operational order, and the staff is well motivated.

3.6.3.2.2 FORT RENO PUMPING STATION

The Fort Reno Pumping Station was placed in service in 1977. It has a pumping capacity of 15.7 mgd and pumps water from the Third High Service Area to the Fourth High Service Area. The station is located on the same site as the Fort Reno Elevated Tank No. 2 and Fort Reno Reservoir Nos. 1 & 2. The Fort Reno Elevated Tank No. 2 has been placed out of service as the new variable speed pumping capabilities serve as the pressure controlling equipment for the Fourth High. The higher service pressure in the Fourth High is presently higher than the overflow level of the elevated tank. Also, the abandoned former Fort Reno Pumping Station and Elevated Tank No. 1 are located on the same site. Fort Reno Pumping Station has a firm capacity of 15.7 mgd, which exceeds current and projected (2035) maximum demand conditions plus maximum fire flow demands. Capital Project AY Upgrades to Ft. Reno Pumping Station have been completed in FY 2018 at $13.6M.

Condition Assessment

DC Water has completed projects that remedied the structural and mechanical components of the Fort Reno Pumping Station. The upgraded pumping station is in like-new condition with redundant variable speed pumps with local and remote control and monitoring features. The new emergency power generator set is exercised and maintained on a programmed schedule.

The current condition of the Fort Reno Pumping Station was provided during an interview and site inspection on February 28, 2018. The housekeeping discipline at the multi-purposed site was exceptional, including the water quality laboratory.

3.6.3.2.3 ANACOSTIA PUMPING STATION

DC Water is in the construction phase of upgrading the Anacostia Pumping Station to improve power and control systems, add pumps for the new Anacostia First High South Service Area, and maintain the reliability of the Anacostia 1st and 2nd High Service Area distribution systems. The Anacostia Pumping Station has a firm capacity of 62.5 mgd. The pumping station supplies the Anacostia 1st, 2nd, & 3rd High service areas. This site was not inspected during this review period.

3.6.3.2.4 16TH AND ALASKA PUMPING STATION

At 3.5 mgd capacity, the 16th and Alaska Pumping Station pumps water from the Third High Service Area to the Fourth High Service Area. The pumping station was built in 1993. The 16th & Alaska Pumping Station has a firm capacity of 3.5 mgd, which exceeds current and projected (2035) maximum demand conditions plus maximum fire flow demands. The upgrades to the pumping station were completed in FY 2015. The $4.6M project has increased the reliability and serviceability of the station that supplies water to the 4th High East from the 3rd High Service Area. This site was not inspected during this review period.

3.6.4 WATER STORAGE FACILITIES

Exhibit 3-12 summarizes the eight storage facilities DC Water owns and operates. Five of these facilities are underground reservoirs and three are elevated tanks. Three additional underground reservoirs are owned and operated by the Aqueduct; these facilities are the Foxhall and Van Ness Reservoirs and the Fort Reno Reservoir No. 2. These facilities combine for a total storage capacity of 110 million gallons and provide adequate storage for DC Water's service area.

Exhibit 3-12: Water Storage Facilities

Facility Name	Service Area	Construction (Upgrade Project)	Capacity
Brentwood Reservoir	Low Service	1959 (2014)	25 MG
Soldiers' Home Reservoir	1st High	1939 (2003)	15 MG
Fort Reno Reservoir No. 1	3rd High	1928 (2016)	5.4 MG
Fort Reno Elevated Tank No. 2 (out of service)	4th High	1926 (2000)	0.16 MG
Fort Stanton Reservoir No. 1	Anacostia 1st High (Proposed Anacostia 1st High)	1932 (2000)	3 MG
Fort Stanton Reservoir No. 2	Anacostia 1st High (Proposed Anacostia 1st High)	1943 (2020)	10 MG
Good Hope Elevated Tank	Anacostia 2nd High (Proposed Anacostia 3rd High)	1937 (2025)	0.5 MG
Boulevard Elevated Tank	Anacostia 2nd High (Proposed Anacostia 3rd High)	1945 (2025)	2 MG

The five storage reservoirs and three elevated tanks operated by DC Water were originally constructed between 1926 and 1959 with an average age of approximately 75 years. Rehabilitation work at these facilities is ongoing and includes site improvements, new instrumentation, upgrades to structural components, painting of the steel tanks, and green infrastructure.

3.6.4.1 WASHINGTON AQUEDUCT STORAGE FACILITIES

3.6.4.1.1 FOXHALL RESERVOIR

The Foxhall Reservoir stores drinking water for distribution in the First High Service Area. This reservoir is a 14.5 mg, below-ground facility and was built in 1941. Water levels in the reservoir are operated to control pressure in the First High Service Area.

3.6.4.1.2 VAN NESS RESERVOIR

Built in 1931, the Van Ness Reservoir provides drinking water storage for delivery to the Second High Service Area. This below-ground reservoir has a storage capacity of 14.6 mg and overflow elevation of 335 feet. The water level in this reservoir is operated to control pressure in the Second High Service Area.

3.6.4.1.3 FORT RENO RESERVOIR NO.2

This reservoir was built as a 20-mg drinking water storage facility in 1955. Along with Fort Reno Reservoir No. 1 (owned and operated by DC Water), this reservoir provides water to the Third High Service Area and is used to control pressure in this service area. Fort Reno Reservoir No. 2 has an overflow elevation of 423.5 feet.

3.6.4.2 DC WATER STORAGE RESERVOIRS AND ELEVATED TANKS

In addition to the existing water storage tanks, the $36.9M St. Elizabeth's Elevated Tank is scheduled to be completed in FY 2019. The 2.0 MG elevated tank will control pressure in the Anacostia 1st High South service area. In order to replace the Ft. Reno Elevated Tank No. 2, a capital project exists to site, design and construct a 2MG 4th High Storage Tank. Project completion is projected to be FY 2024 at $9.6M. A 2nd High Water Storage facility is being studied to augment Washington Aqueduct's Van Ness reservoir, which has the capacity to supply 65% of the 2nd High's average daily demand. Redundancy of tanks allows for the out-of-service rehabilitation of a tank. The 2nd High storage FY 2017-2026 capital project is $16.8M to be completed in FY 2025.

DC Water is following best practices in assessing the condition and security of water storage facilities. EPA regulations for protecting drinking water have been incorporated within the water storage capital improvements. The CIP adequately addresses DC Water's storage reservoir and elevated tank requirements. The operating budgets fund the on-going cleaning and disinfection of the storage facilities performed by outsourced services on a three-year cycle.

3.6.4.2.1 FORT RENO RESERVOIR NO. 1

The Fort Reno Reservoir No. 1 is one of the drinking water storage facilities serving DC Water's Third High Service Area. The reservoir was built in 1928 and is a below-ground facility with storage capacity for 5.4 million gallons of water. Water levels in this reservoir, along with Fort Reno Reservoir No. 2, are used to control pressure in the Third High Service Area. The reservoir has an overflow elevation of 424 feet.

Condition Assessment

On February 28, 2018, JMT inspected the reservoir and found the sanitary measures stipulated by the EPA are in place and enforced. The green infrastructure roof is being maintained.

3.6.4.2.2 FORT RENO ELEVATED TANK NO. 2

The Fort Reno Elevated Tank No. 2 is an elevated steel tank within a stone masonry building. The tank is currently in the process of being decommissioned due to functional obsolescence. Variable speed pumping capabilities in the Fort Reno Pumping Station have surpassed this tank's pressure controlling capabilities in the service area. Redundancies within the pumping capabilities and limitations to capacity have rendered this tank obsolete.

Condition Assessment

On February 28, 2018, JMT inspected the out-of-service elevated tank and found the asset is being maintained in an operationally ready condition.

3.6.5 TRANSMISSION AND DISTRIBUTION – MAINS & APPURTENANCES

3.6.5.1 TRANSMISSION MAINS

DC Water owns and maintains approximately 250 miles of transmission mains (16-inch diameter and greater.) DC Water has an existing Large Diameter Water Main Rehabilitation/Replacement program (LDWM). A detailed field analysis of existing transmission mains, prioritized in the 2015 Facilities Plan Update, continues within the Pipe Condition Assessment (PCA) with five miles of high-risk pipes analyzed annually. Field inspections and leak detection are used to develop capital projects addressing specific sections of pipe in various transmission mains requiring repair or replacement.

Steel pipes in the system account for the highest number of breaks in the entire system when indexed on a number of breaks per unit length basis. It has been determined that the high occurrence of breaks in steel water mains is most probably due to the effects of corrosion to the pipe material and couplings. As anticipated, very few of the pipelines surveyed were provided with corrosion protection systems, and the systems that were in place appeared to be in disrepair. This is typical for steel transmission mains that are not adequately protected against corrosion. The lining of the 24-inch steel main at Rock Creek (project DF) was completed in 2016 at a reduced project cost of $0.376M. Project F6, Steel Water Mains Rehabilitation Phase I, is a project addressing cathodic protection upgrades to protect high priority mains. Noteworthy transmission main CIP projects are listed in **Exhibit 3-15**. Project C9, Large Diameter Water Mains 1, calls for the replacement of a 30-inch cast iron main installed in 1859. By all measures, the main, located in MacArthur Boulevard and points south, is one of the oldest large mains in the country. The $19.3M project is programmed for FY 2020.

Exhibit 3-15: Transmission Main Projects

Transmission Mains Projects	Recommended Improvements	Cost	Timeline
C9	Large Diameter Water Mains 1	$19.3M	Completion FY 2020
F6	Steel Water Mains Rehabilitation Phase I	$9.9M	Completion FY 2020
FE	20” Low Service Main & PRV	$8.0M	Completion FY 2018
FT	Water Mains Rehab Phase II	$40.0M	Completion FY 2024
GU	Crosstown Water Main Rehabilitation	$12.7M	Completed 2014
GX	Large Dia. Water Main Repl. II	$23.2.0M	Rescheduled for 2029
JZ	Large Dia. Water Main Repl. 3,4&5	$63.7M	Completion FY 2027
S5	Large Diameter Water Main Int. Repairs	$17.0M	Completed 2016

Condition Assessment

The progress and results of the transmission main rehabilitation projects were provided during an interview on February 20, 2018. The Department of Engineering and Technical Services has developed a Facilities Plan that addresses the aging infrastructure.

3.6.5.2 DISTRIBUTION MAINS

The installation history and general material of construction of the distribution mains (12-inch diameter and smaller) is well documented in DC Water records. Approximately 740 miles of distribution mains are unlined cast iron pipe that are known to be tuberculated, which reduces hydraulic capacity and is a potential water quality concern. The 2015 Facilities Plan Update identifies approximately 245 miles of pipe over a hundred years old. There are many factors that dictate replacement strategy; however, it is generally accepted that the useful life of water mains is 100 years. The 2015 Facilities Plan update continues the recommended 1% replacement per year. The FY 2017-2026 Capital Improvement Program adheres to the 1% per year replacement as recommended. The new replacement program began in FY 2010 with full implementation of the small water main program in FY 2014 and the large water main program in FY 2016.
Distribution main projects are listed below in **Exhibit 3-16**. The illustrated projects satisfy the 1% per year replacement metric.

Exhibit 3-16: Distribution Main Projects

Distribution Mains Projects	Recommended Improvements	Cost	Timeline
DE	Small Diameter Water Main Rehab 12	$39.9M	Completion FY 2020
F1	Small Diameter Water Main Rehab 13	$31.2M	Completion FY 2020
F2	Small Diameter Water Main Rehab 14	$40.1M	Completion FY 2021
GR	Small Diameter Water Main Rehab 15	$39.8M	Completion FY 2022
MV	Small Diameter Water Main Rehab 03	$15.6M	Completion FY 2020
MX	Small Diameter Water Main Rehab 05	$9.0M	Completed FY 2016
N9	Small Diameter Water Main Rehab 07	$17.0M	Completion FY 2015
O0	Small Diameter Water Main Rehab 08	$20.7M	Completion FY 2019
O1	Small Diameter Water Main Rehab 09	$25.0M	Completion FY 2018
O2	Small Diameter Water Main Rehab 10	$36.8M	Completion FY 2019
O3	Small Diameter Water Main Rehab 11	$39.0M	Completion FY 2018

Condition Assessment

The DETS interview on February 20, 2018 indicated that the restructuring of the design element of small water main replacement from design consultants to in-house engineers has been successful and has exceeded the design parameter 1% per year replacement metric.

3.6.5.3 APPURTENANCES

3.6.5.3.1 CONTROL VALVES

Control valves are often referred to as the heart of a distribution system. The ability to isolate sections of water mains for repairs is vital to providing a safe and dependable supply of water. Larger transmission mains when required to be isolated for repair have substantially large valves. These large valves are under considerable forces developed by the flow of water and system pressures. Functioning valves reduce the service interruption during emergencies. Most importantly, the number of customers affected is greatly reduced as the isolation does not require expanding the shut-off zone to reach operable valves. Project BZ, Large Valve Replacement, was a $12.7M replacement effort for the replacement of 40 broken valves on large diameter mains, which was completed in 2017.

Condition Assessment

DC Water has completed projects within the 2013-2017 review period. The Water Utility Services interviews on February 6, and 21, 2018 indicated improved reliability within the water system due to the new valving in critical areas. The system's reliability will further improve based on the planned projects outlined in **Exhibit 3 -17**.

Exhibit 3-17: Valve Replacement Projects

Appurtenances Projects	Recommended Improvements	Cost	Timeline
BZ	Large Valve Replacement (Contract 08-10)	$12.7M	Completed FY 2017
I8	Large Valve Replacement (Contract 11-13)	$17.7M	Completion FY 2020
IB	Large Valve Replacement (Contract 17-19)	$20.0M	Design May 2018
KA	Large Valve Replacement (Contract 20-22)	$17.6M	Completion FY 2027
KB	Large Valve Replacement (Contract 23-25)	$19.2M	Completion FY 2029

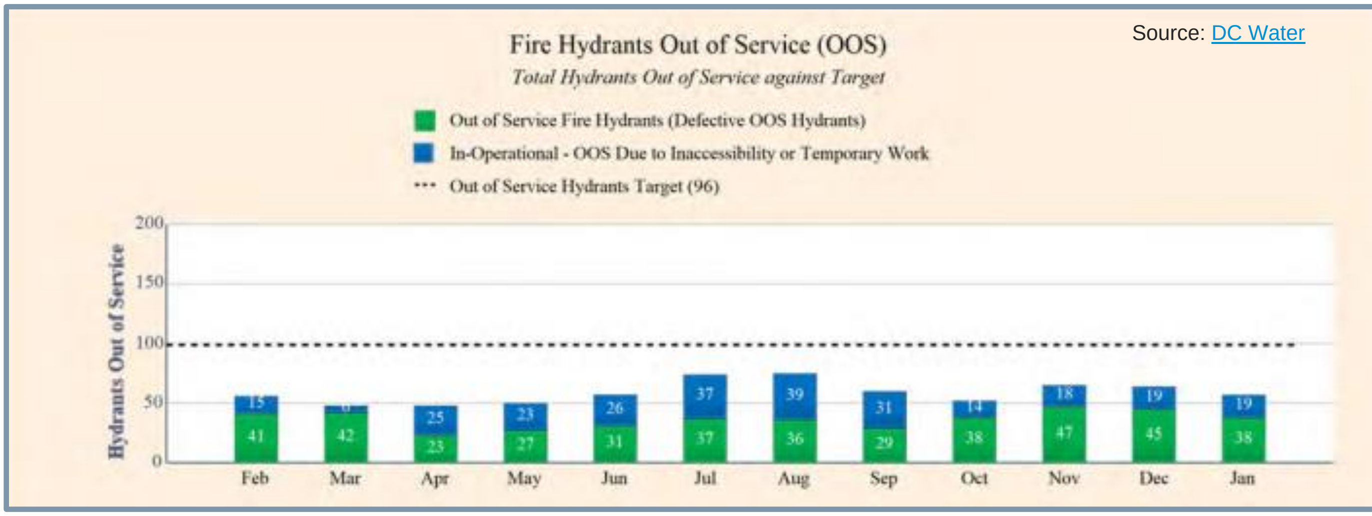
3.6.5.3.2 FIRE HYDRANTS

A Memorandum of Understanding (MOU) between DC Water and the District of Columbia, through the District of Columbia Fire and Emergency Medical Services Department, is in place and DC Water continually measures its performance based on this MOU. This agreement implements an improvement program in the operational level of fire hydrants within the District. DC Water is firmly committed to ensuring the availability and accessibility of public fire hydrants to the District of Columbia Fire Department (DCFD) so that they can provide superior fire protection within the District. DC Water has a Fire Hydrant Service Status Program that measures the performance of maintenance, repair and replacement of public fire hydrants in the District while simultaneously keeping the public informed. The report measures the number of public hydrants, identifies how many are out of service, maps the locations, indicates how many require repair or replacement, and recognizes the reason for being out of service. These measures are continuously monitored and a detailed report and explanation is provided every month to the Environmental Quality and Operations Committee, and each quarter and the full Board of Directors.

DC Water has established the goal of 1% or less Out-of-Service (OOS) for public fire hydrants. The December 4, 2017 report to the Environmental Quality and Operations Committee showed a 4-month trend between 0.25% and 0.38% OOS This range is typical of earlier reports that have been monitored by JMT over the 2013-2017 review period.

The FY 2017-2026 CIP dedicates $28.2M to the Fire Hydrant Replacement Program, Project GQ. This program replaces and upgrades fire hydrants. The replacement effort has been transferred from contractors performing the replacement to Water Utility Services personnel. In 2017, the goal of 500 replacements per year was achieved by Water Utility Services. Replacement and maintenance costs of hydrants are reimbursed by the DC Government. The target level of service for hydrants has been exceeded during the assessment period; **Exhibit 3-18** illustrates the prior year’s monthly levels of Out of Service hydrants against target levels.

Exhibit 3-18: Fire Hydrants Out of Service



Source: DC Water

DC Water maintains a high level of transparency for the fire hydrant program by publishing quarterly reports that depict the location and number of fire hydrants that are defective, obstructed, temporary, and under construction. These reports are readily available on DC Water's website, demonstrating DC Water's commitment to maintaining working fire hydrants.

3.6.5.3.3 LEAD SERVICE LINE REPLACEMENT POLICY

DC Water continues to address lead service lines with operational, testing, and replacement policies. Water samples for lead from some homes in the District indicated lead was leached into drinking water from lead service lines during a period from 2001 to 2004. Since 2004, following a change in water chemistry within treatment processes, the District of Columbia's drinking water has met federal limits for lead and is in full compliance with U.S. Safe Drinking Water Act regulations, including the Lead and Copper Rule. In response to the elevated lead samples, DC Water (then WASA) initiated a program to comply with the Lead and Copper Rule, which included an accelerated capital program to locate and replace lead service lines throughout the District. This program was revised by the Board of Directors in 2008 following a scientific review of the impacts of partial lead service line replacement on drinking water.

The Lead Service Line Replacement Policy (LSLR), as revised by the Board of Directors, encourages property owners to replace the private portion of the lead pipe in conjunction with DC Water replacing the public portion of the service line. Lead service lines in public space (between the main and the property line) continue to be replaced with copper pipe in conjunction with DC Water's ongoing water main replacement projects, DDOT projects and developer activities. During these water main replacement projects that include replacing the public service lines, DC Water strongly encourages homeowners to replace private-side lead pipes. DC Water offers the private lead service replacements during their projects at contractual rates that may be discounted compared to other contractors. DC Water also offers a cost reimbursement plan of up-to four monthly payments to these homeowners.

In addition to service line replacements, the ongoing LSLR efforts encompass outreach efforts: online information - including a map of all service line materials, mailings, and door-to-door (during construction projects); lead testing for customers; and distributing filters to customers receiving lead service replacements. The ten-year CIP, FY 2017 – FY 2026 projected expenditure for project BW, Lead service Replacement Program, is $18.5M. The lifetime cost is projected to be $209M.

3.6.6 RATEPAYER METERING

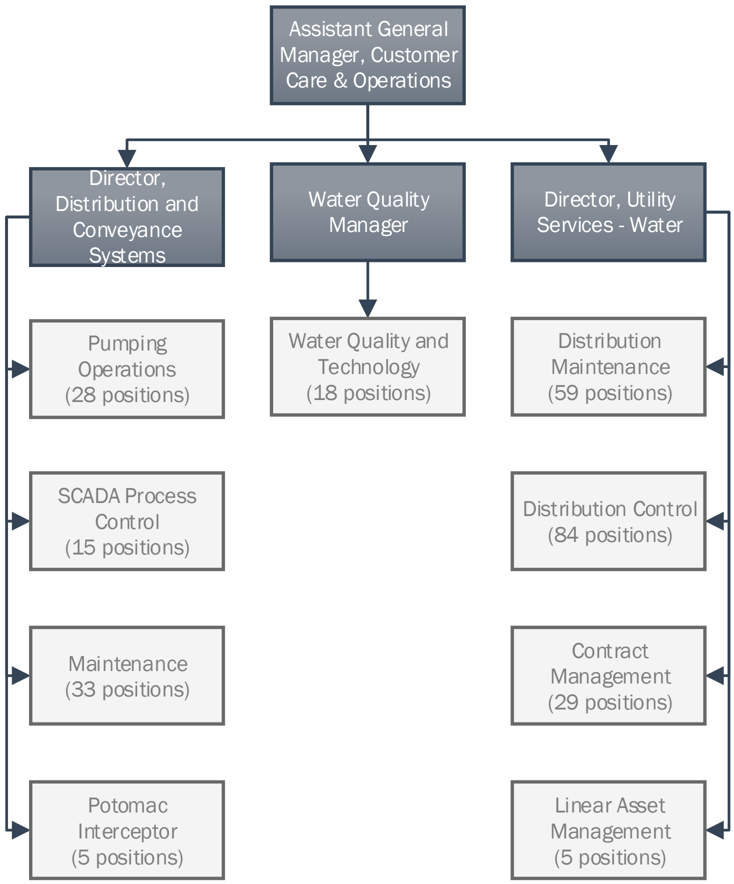
DC Water was one of the first utilities to adopt automated meter reading (AMR), a noted best practice in the industry. The automated meters use radio frequency and cellular phone technology to send water usage information from the meter to DC Water. In addition, an innovative application was developed in-house for notifying customers about their water use. The so-called High Use Notification Application (HUNA) tool analyzes daily water consumption and provides monthly and yearly averages on each account. It also allows customers to access daily meter readings via the web and has advanced features which alert customers of metering anomalies.

The AMR and the Customer Service Information and Billing System help DC Water minimize estimated billings; decrease meter investigations by field staff; reduce the cycle time to identify and correct erroneous billings; identify meter issues; and provide modern data analytics-based services. The CIP project for the AMR Replacement Program is a Capital Equipment project, EQP2340. The goal is to replace 90,000 water meters, with corresponding transmitting units by FY 2018. The Lifetime approved budget is $33.2M, reduced from the earlier estimate of $50.7M.

3.6.7 ORGANIZATIONAL

The Customer Care & Operations team is responsible for operating the water system. Utility Services - Water maintains the water transmission and distribution systems throughout the District. Distribution and Conveyance Systems is responsible for the pumping and storage facilities for the water system. Water Quality and Technology (WQT) monitors drinking water quality. The following **Exhibit 3-19** presents the organizational structure dedicated to the Water System's Operations and Maintenance.

Exhibit 3-19: Water Utility Services Organization Chart



3.6.8 ASSET MANAGEMENT

Since the 2013 assessment, pursuant to DC Water's Blue Horizon 2020 Strategic Plan, DC Water has made significant progress toward optimally managing its infrastructure. One of the most significant achievements on this front during this assessment period is the continued implementation and progressive maturity of its Asset Management (AM) Program. DC Water has intentionally sought, developed, and authorized policies and practices that enhance its abilities to optimally manage its infrastructure assets. DC Water has also purposefully organized and empowered its management at all levels of the organization to achieve AM goals. Planning and management studies have reviewed and recommended changes to policy and governance - that have been or are being implemented - to empower the role of AM within the organization. The result for DC Water is a shift of its infrastructure AM from a reactive management model toward a proactive one.

The proactive management approach is built around utility AM practices. Utility AM is a paradigm shift in utility management. Modern utilities are moving away from a build and operate infrastructure model toward actively managing the performance of their infrastructure assets. Some of the goals of this shift are to extend the lifecycle of assets, optimize maintenance and renewal, sustain long-term performance, and develop accurate long-term funding strategies. These practices generally incorporate ideas that allow utilities to operate more efficiently, providing the same or increased levels of service to customers with correspondently less or the same level of funding.

This shift is occurring due to a variety of factors, but aging infrastructure, loss of technical expertise due to retirements, public resistance to rate increases, and increasing demand on utility services all figure prominently. When a utility applies AM practices to infrastructure at all levels of the organization, it is empowered to minimize total costs with limited resources while delivering service levels required by customers and regulators, all at acceptable levels of organizational risk. AM assesses the total cost of ownership throughout the asset lifecycle – acquisition, operations maintenance, and renewal.

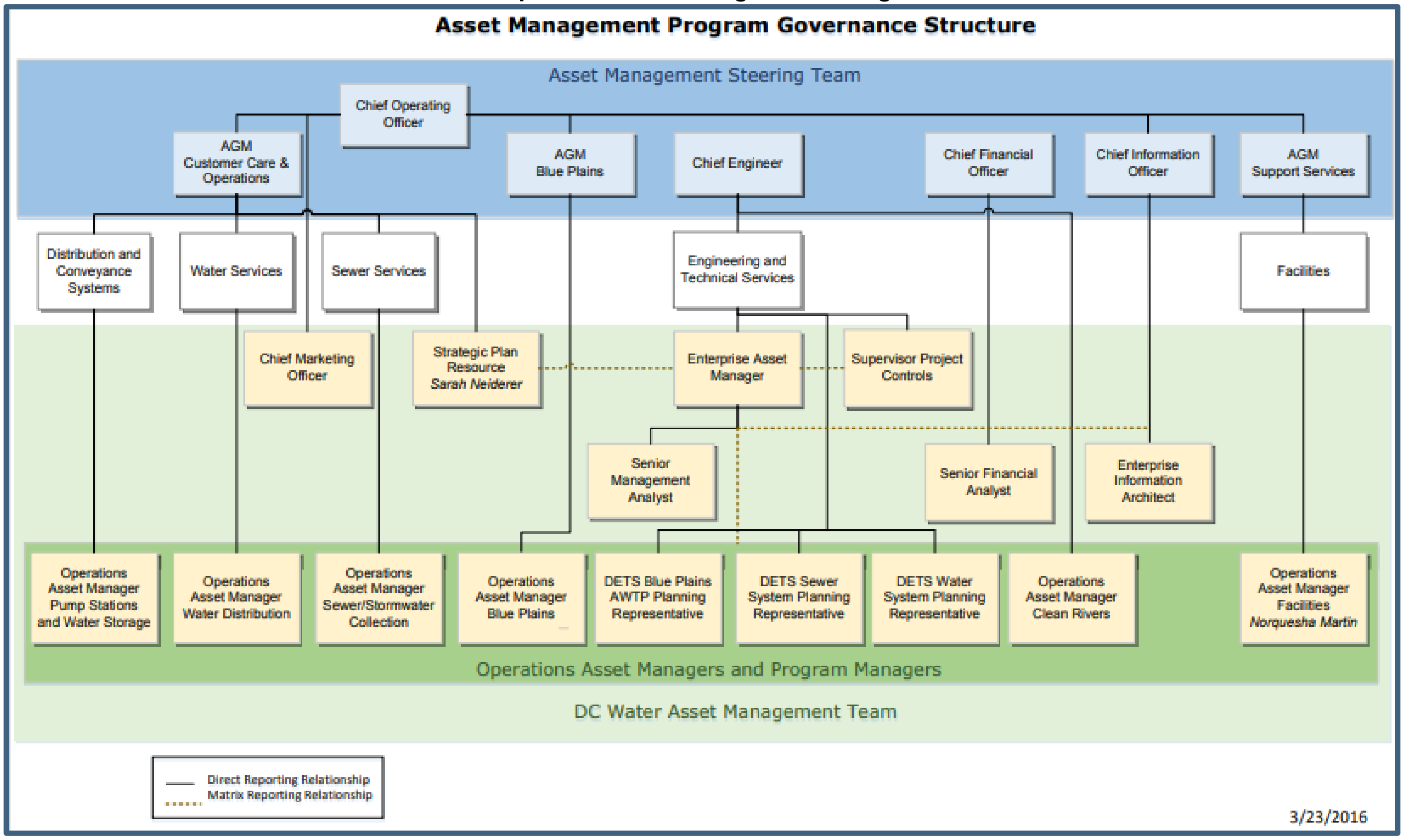
JMT reviewed DC Water's Enterprise Asset Management Plan (EAMP) to assess the role of AM within the organization. Based on this review, DC Water is undertaking its Asset Management implementation with the assistance of industry leaders and with the guidance of industry standards. ISO 55000, an industry standard for the management of physical assets, is cited within DC Water's Enterprise Asset Management Plan as key guidance ***"to guide DC Water to eventually achieve world-class AM status"***. ISO 55000 identifies high level standards for AM decision making, setting forth tools (reliability engineering, risk analysis, financial discounting, and life cycle costing analysis) that can be used in the process. In addition, one of the most important standards it sets is that of decision making criteria that are documented, transparent, proportionate, and consistently applied.

The EAMP places significant priority upon the systematic assessment of DC Water's infrastructure assets. At a high level, this plan accomplishes these goals:

- Groups all major types of operational assets, provides condition and performance assessments of each class indexed with a variety of relevant metrics such as age, length, diameter, estimated useful life, and replacement cost for each.
- Assesses the current, desired, and appropriate service levels for the water, sewer, and wastewater treatment service lines, and establishes key performance indicator (KPI) metrics for each.
- Evaluates the risk levels for each asset class.
- Identifies needed support systems required through role competencies and software support systems. Primary support systems include Geographic Information Systems, existing program level assessment databases, and Maximo, the enterprise asset management solution.
- Historical and forecast capital models, including funding sources.
- Summarized capital investment needs by service line.

ISO 55000 places a high priority on cross-disciplinary teamwork to achieve the organizational goals of AM. This is best achieved through appropriate engagement in AM by the organizational governance. The EAMP clearly identifies the DC Water's organizational governance as it pertains to AM. **Exhibit 3-20** shows this structure.

Exhibit 3-20 Enterprise Asset Management Program Governance



In addition, the EAMP defines a clear AM policy, which declares the following principles for DC Water's AM program.

- **Customer Focused** by meeting levels of service based on ratepayer and community preferences.
- **Whole Life-Cycle Based** by considering asset resource and financial requirements from planning, design, construction/acquisition and commissioning, through operation, maintenance and renewal, to retirement and disposal.
- **Sustainable and forward-looking** by considering social, environmental and financial aspects in present and future service commitments.
- **Transparent and defensible** by using formal, consistent, scalable, and repeatable approaches.
- **System-View** by managing assets as interrelated components in a unified system rather than as stand-alone assets.
- **Innovative** by continually improving asset management processes and procedures using innovative tools, techniques and solutions.
- **Reliability-Focused** by understanding consequences of asset failure and implementing appropriate maintenance processes to reduce likelihood of asset failure.
- **Regulatory-Driven** by ensuring compliance with laws, regulations, permits, Consent Decrees, Administrative Orders and other legal requirements.
- **Managed Risk** by directing resources and priorities to achieve established levels of service while minimizing life cycle costs at an acceptable level of risk.

AM is being implemented across the DC Water organization in planning, operational, and maintenance functions. Organizationally, the Linear Asset Manager (within Water Services) is responsible for the linear (distribution and collections) assets; however, similar functions exist in the Department of Distribution and Conveyance, and in the Wastewater Treatment Plant Operations. Additionally, the Department of Engineering and Technology is largely responsible for the strategic planning for these implementations.

In implementing its asset management program, DC Water has performed extensive inventory of its infrastructure. It has performed condition assessments of the systems and assets it operates and maintains. They know where assets are and are continually improving this information based upon real world data collection performed by its operations and maintenance staff. The organization is continually pursuing and evaluating tools and software systems that further its capabilities to perform these duties. In doing so, DC Water has integrated its enterprise asset management software into mobile and vehicular applications that enhance its AM data collection abilities. Throughout numerous interviews with managers at all levels of the organization, the AM program, software, scheduling capabilities, and analytics enabled by its systems were cited as improvements and initiatives that enhance DC Water’s abilities to achieve peak performance.

One excellent example of an AM initiative cited during interviews is that DC Water is currently undertaking efforts to achieve maintenance in ways that ensure the continued operation of critical infrastructure while also modeling capital effectiveness. In interviews with management, reliability centered maintenance (RCM) for critical assets was cited as an example of an initiative that will yield operational efficiencies and improve service levels.

Other initiatives include pioneering the use of innovative inspection technologies (e.g., SewerBatt, MTA Pipe-Inspector, drones) and working with contractors to conduct specialty inspections, and condition assessments (e.g., radar, Redzone Robotics).

SECTION 4 WASTEWATER SYSTEMS

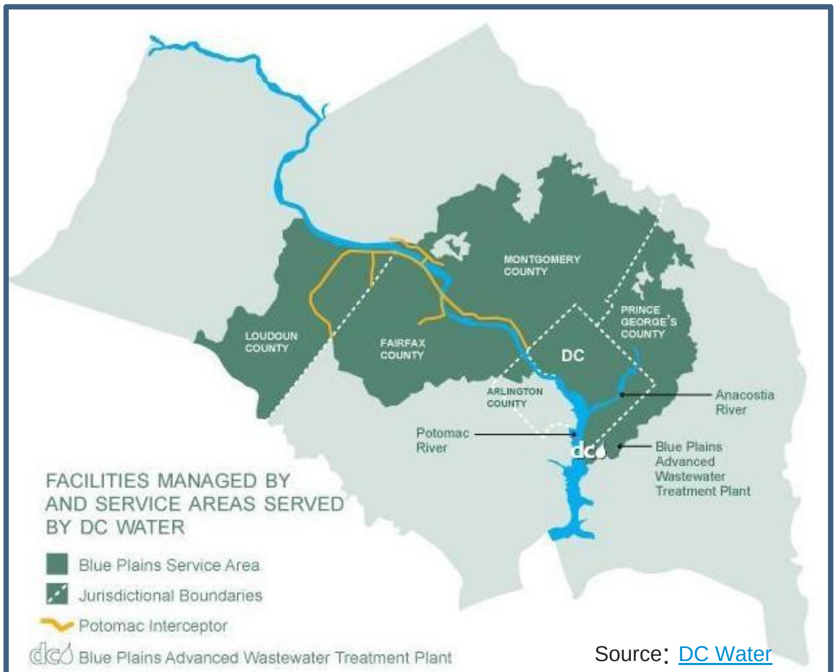
4.1 OVERVIEW

DC Water provides regional wastewater treatment and collection services to the District of Columbia and for wholesale customers in adjacent Maryland and Virginia Counties. DC Water's wastewater service area is shown graphically in **Exhibit 4-1**. This service area is stable geographically with no significant expansion foreseen.

Collected wastewater is conveyed to DC Water's Blue Plains Advanced Wastewater Treatment Plant (Blue Plains) located in Southeast D.C. near the confluence of the Anacostia and Potomac Rivers. The Plant is located between Bolling Air Force Base and the Woodrow Wilson Bridge. Collection of wastewater is conveyed, largely by gravity, through a complex system of pipes and tunnels, which can exceed 100-years in age, 12 feet in size, and by nine wastewater pumping stations. Wastewater from areas in Virginia and Maryland is conveyed via the Potomac Interceptor, the Anacostia Interceptor and the Rock Creek Interceptor**.** Treatment at Blue Plains includes liquid processes and residual solids processing. Blue Plains organization and management, as well as this report, are loosely based on these processes.

DC Water's Clean Rivers Project manages the Long Term Control Plan (LTCP) and is reviewed in Section 5 of this report. The combined sanitary and storm collection system located within the older communities of Washington DC are largely funded by the District and not supported by wholesale customers outside the District of Columbia.

Exhibit 4-1: DC Water Wastewater System Service Area



Source: DC Water

4.2 WASTEWATER AGREEMENTS

DC Water is party to agreements pertaining to wastewater collection and treatment. These contracts, are summarized in **Exhibit 4-2**.

Exhibit 4-2: Wastewater Agreements

Agreement	Date Signed	Parties
Potomac Interceptor Agreement	1963	• The Authority • Dulles International Airport • Department of Navy • National Park Service • Town of Vienna
Chesapeake Bay Agreement	1983	• District of Columbia • Maryland • Pennsylvania • Virginia • U.S. Environmental Protection Agency • Chesapeake Bay Commission
Blue Plains Intermunicipal Agreement (IMA)	2013	• The Authority • Fairfax County, VA • Montgomery County, MD • Prince George's County, MD • Washington Suburban Sanitary Commission
Loudon County Sanitation Authority Agreement	1998	• The Authority • Loudoun County Sanitation Authority

Most wholesale customers in Virginia and Maryland are allocated a predetermined share of the operating and capital costs based upon the IMA. A few smaller users of the Potomac Interceptor Agreement pay through rates that are reconciled and adjusted at three-year intervals. Descriptions of the various agreements were previously provided in the 2013 Assessment.

4.3 BLUE PLAINS ADVANCED WASTEWATER TREATMENT PLANT

Blue Plains is the largest wastewater treatment plant in the metropolitan Washington region and is the largest advanced wastewater treatment plant in the world. In its 80-year history, Blue Plains has undergone a number of treatment upgrades and advances while expanding both the quality of treatment and the area of the metropolitan area served. According to the Metropolitan Washington Council of Governments, approximately 48 percent of the region's current wastewater treatment capacity is at Blue Plains, serving millions of residents, businesses, and visitors in its multi-jurisdiction service area that includes the District of Columbia and significant portions of Montgomery and Prince George's Counties in Maryland and Fairfax and Loudoun Counties in Virginia.

Blue Plains has undergone a state of rapid change in treatment and energy recovery enhancements as significant construction has occurred to meet NPDES permit and Chesapeake Bay Agreement-related process improvements. These projects are described in more detail and subsequent sections of this report. **Exhibit 4-3** shows the treatment facility layout for Blue Plains.

Exhibit 4-3: Blue Plains Wastewater Treatment Plant Facility Layout

4.3.1 PERMIT COMPLIANCE

Blue Plains operates and subsequently discharges treated effluent into the Potomac River under an NPDES permit executed September 30, 2010. The 2010 NPDES permit expired on September 30, 2015 but has been administratively extended. A Public Notice Draft Fact Sheet for Permit # DC0021199 was released September 1, 2017. This new permit will be effective 30 days after final determination, if no petition for review by the Environmental Appeals Board is filed within 30 days after receipt of the final determination. Interviews with the Wastewater Treatment Operations personnel on March 2, 2018 confirmed that DC Water is in compliance with its current permit requirements.

The 2010 NPDES permit established discharge limits for the DC Water’s two outfalls at Blue Plains in accordance with the provisions and implementing regulations of the Federal Water Pollution Control Act (Clean Water Act, or CWA). The permit standards governing the discharge are among the most stringent effluent limits.

The Clean Water Act prohibits discharges to United States waters that are not authorized under an NPDES permit. NPDES permits set numerical discharge limits and establish mandated action schedules for treatment plants to meet requirements. Permits also require monitoring and monthly Discharge Monitoring Reports (DMR) be submitted to EPA. In DC Water’s case, when a permit violation occurs, the incident is reviewed by the EPA Region III, which will require compliance and could resort to punitive measures.

DC Water has performed well, meeting Blue Plains’ NPDES permit requirements and receiving recognition from the National Association of Clean Water Agencies (NACWA). NACWA recognizes water agencies for their NPDES compliance. DC Water received a Platinum Award in 2016, following five consecutive years’ compliance. The Platinum Award (pictured at right) is the highest award by NACWA.

Image: DC Water File

Blue Plains’ two outfalls are regulated by the NPDES permit. The permit requirements are designed to make allowances for Combined Sewer System Flow (CSSF) instances. Outfall 002 discharges effluent that has passed through complete treatment at Blue Plains; whereas, outfall 001 is designated as an approved CSO-related bypass in the NPDES permit. During Dry Weather Flow (DWF), only Outfall 002 is utilized. Construction of the Enhanced Clarification Facilities, as well as upgrades to the Nitrification and Denitrification Facilities, was addressed in the permit with flow limits during construction at Outfall 002. The flow requirements of the 2010 NPDES permit are detailed in **Exhibit 4-4** for Outfall 002 and **Exhibit 4-5** for Outfall 001. These permit limits are the flow metrics used for this review of the 2013-2017 period of DC Water’s operations.

Exhibit 4-4: Blue Plains Outfall 002 Permit Requirements

Flow Condition and Period	Times	Measured Influent Flow Rates to Receive Complete Treatment
A. DWF	All times	Up to and including 511 mgd
B. CSSF		
1. From Effective date of permit and following placing ECF in operation unless otherwise authorized or approved by EPA.	First 4 hours After 4 hours	Up to and including 555 mgd and Up to and including 511 mgd
2. Until Completion of Nitrification Denitrification Facilities upgrade, but no later than March 1, 2011.	First 4 hours After 4 hours	Up to and including 511 mgd and Up to and including 450 mgd
3. During Construction of Improvements to existing nitrogen removal facilities, period(s) to be determined by permittee and EPA from completion of design and construction schedules.	First 4 hours After 4 hours	Up to and including 511 mgd and Up to and including 450 mgd
4. During Construction of the ECF and tie-ins to the existing facilities. Periods to be determined by permittee and EPA from completion of design and construction schedules.	First 4 hours After 4 hours	Up to and including 511 mgd and Up to and including 450 mgd

Exhibit 4-5: Blue Plains Outfall 001 Permit Requirements

Flow Condition and Period	Times	Measured Flow Rates for Outfall 001
A. DWF	All times	No discharge approved
B. CSSF		
1. From Effective date of permit and lasting until ECF is placed in operation	All times	Up to and including 225 mgd above rates to receive complete treatment under Part 1B for Outfall 002
2. Following ECF being placed in operation, for emptying BPT under an operating routine that provides for:	All times	ECF to treat up to 225 mgd with controlled diversion of effluent to main plant to maintain a rate of 511 mgd.
a. Conveying flow from BPT through the ECF or transfer to complete treatment;		
b. Regulating the discharge of ECF effluent to maintain a rate of 511 mgd through complete treatment while optimizing conditions to maintain the availability of the storage volume in the BPT such that the occurrence of CSO is minimized;		
c. No discharge of flow from BPT from Outfall 001 when DWF conditions exist; and		
d. Limiting discharge of ECF effluent from Outfall 001 to a maximum rate of 225 mgd; provided that any discharge of ECF effluent from Outfall 001 shall not occur except for the purpose of maintaining the availability of the storage volume in the BPT to the extent that the occurrence of CSOs is minimized		

The water quality parameters and limits within the 2010 permit include 4,689,000 pounds per year of total nitrogen (TN). This is equivalent to 4.2 mg/l of TN at 370 mgd average annual flow. Upgrades to the plant were placed in operation by July 1, 2014 and were in compliance January 1, 2015. By the fall of 2014, the Enhanced Nitrogen Removal Facility (ENRF) was in operations. Estimated cost for this reduction in TN is $950 million. Due to the effect of weather on the Nitrification /Denitrification process, the requirements vary seasonally for Ammonia Nitrogen. The TN limit and other effluent limits are shown in **Exhibit 4-6**.

Exhibit 4-6: Blue Plains Outfall Permit Requirements

Parameter	Limit
Total Nitrogen	4.2 mg/L
Carbonaceous Biochemical Oxygen Demand	5.0 mg/L
Total Suspended Solids	7.0 mg/L
Total Phosphorus	0.18 mg/L
Ammonia Nitrogen (NH_3-N) {seasonal limits}:	
5/1 - 10/31	4.2 mg/L
11/1 - 2/14	11.1 mg/L
2/15 - 4/30	12.8 mg/L
Dissolved Oxygen	5.0 mg/L
Total Chlorine Residual	0.02 mg/L
pH	6.0 - 8.5

DC Water's NPDES permit includes sections with detailed information on meeting the stipulated requirements. These sections relate to pretreatment, standard sludge conditions, chlorination/dechlorination, stormwater management, and BOD reduction. The permit also covers monitoring and operations for different flow conditions with respect to each outfall, scenarios for dealing with various phases of construction, parameters and monitoring requirements for the Northeast Boundary Swirl Facility discharge into the Anacostia River. Specific reporting requirements for public accountability are included in the permit for the combined sewer system, nine minimum controls (NMC) program, water quality-based requirements for CSOs, the long term control plan, and CSO status reports and schedules. General conditions in DC Water's NPDES permit outline the duty to comply with the permit and penalties for violations of permit conditions. Subjects dealing with toxic pollutants, oil and hazardous substances, endangered species, and other liability issues are also described in the permit. Operation and Maintenance of Pollution Controls is specifically covered in the permit under the following topic areas:

- Proper operation and maintenance
- Bypass of treatment facilities
- Upset conditions

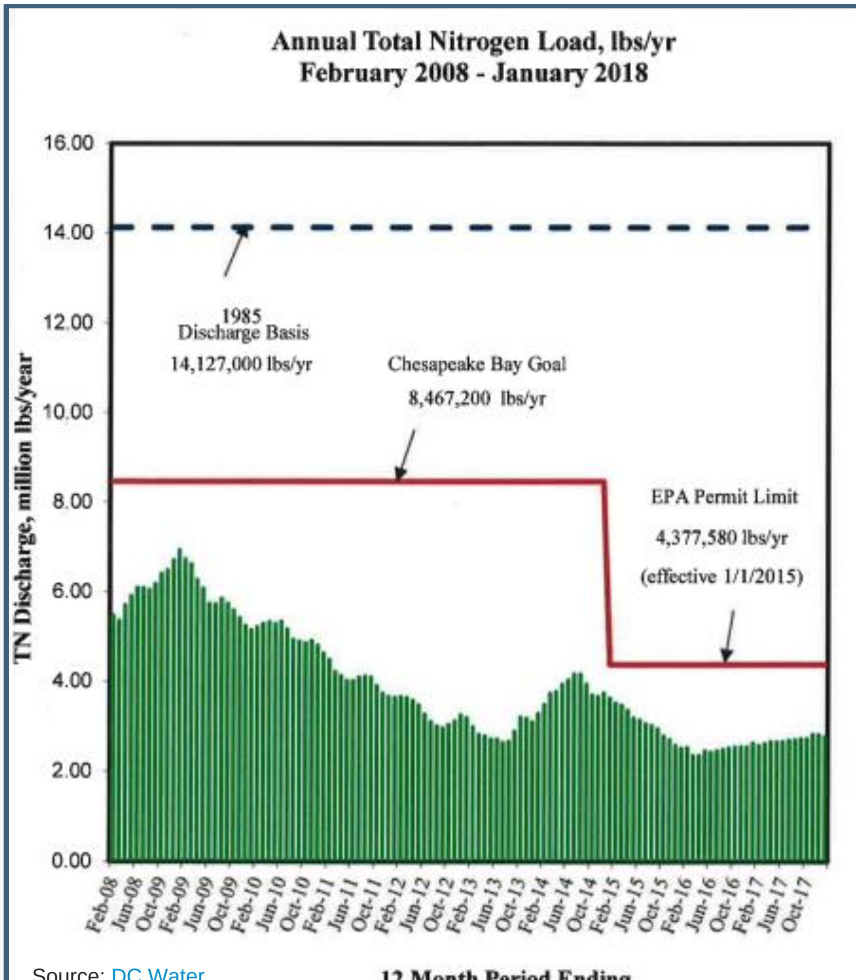
There are detailed explanations of definitions and specific actions necessary in handling these areas of operation and maintenance. There is also a section that covers the specifics on Monitoring and Records. Details are given under the following topic headings:

- Representative sampling
- Flow measurements
- Monitoring procedures
- Reporting of monitoring results
- Monitoring and analytical equipment maintenance
- Analytical quality control
- Additional monitoring by the permittee
- Retention of records
- Record contents
- Inspection and entry

The Authorization to Discharge under the NPDES permit #DC0021199 is a very comprehensive control for flow and water quality addressing Outfalls 001 & 002. The permit is structured like other NPDES permits, with specific stipulations and tiered compliance for Blue Plains operations based on the Consent Decree and Chesapeake Bay Agreement.

The Blue Plains treatment facilities are meeting or exceeding the permit and reporting requirements consistently, as evidenced by the NACWA Platinum Award. It is expected that DC Water will continue to comply with the NPDES permit requirements by following through on schedule with the planned rehabilitation, replacement and other capital improvements. **Exhibit 4-7** shows how the NPDES TN limit is consistently meet by Blue Plains.

Exhibit 4-7: Effluent Total Nitrogen Loads



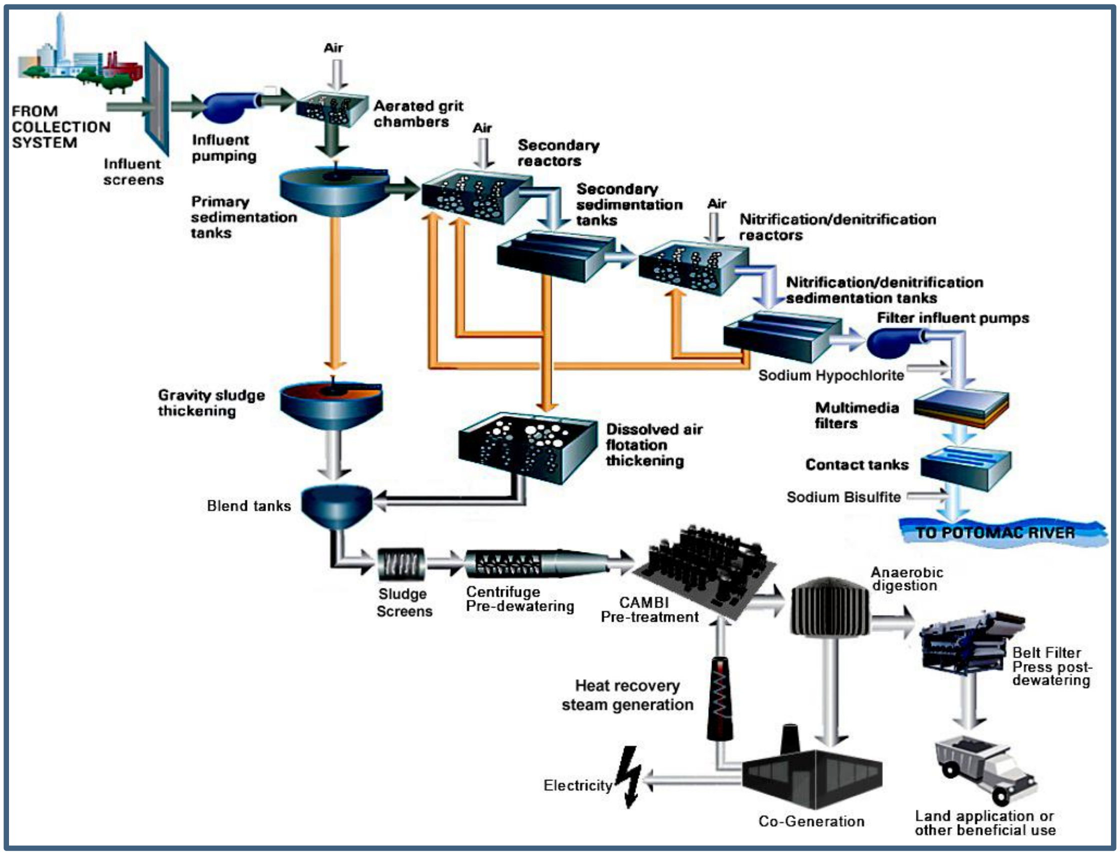
Source: DC Water

With the many capital improvements planned and under way a significant amount of attention is dedicated in improvements to DC Water facilities. It is therefore important that operations and maintenance needs are not neglected. DC Water appears to have taken the right steps to keep the plant and facilities in good working order.

4.3.2 TREATMENT PROCESSES

Exhibit 4-8 below is a graphical representation of the Liquid Processing Treatment Program at Blue Plains. Each is described in more detail in subsequent sections.

Exhibit 4-8: Blue Plains Treatment Process



4.3.3 WASTEWATER PRETREATMENT REQUIREMENTS

DC Water regulates the quality of the wastewater entering Blue Plains from wholesale and large retail customers to ensure treatment processes and collection systems are not disrupted and the Plant continues to comply with its NPDES permit. Pretreatment programs are required and approved by the EPA to ensure compliance with NPDES federal discharge limitations. DC Water permits and monitors each significant industrial user that has the potential to discharge dangerous levels of pollutants into the sewer system. DC Water also monitors permitted commercial wastewater (domestic or industrial) haulers that discharge and dispose hauled wastewater to the Blue Plains.

DC Water levies fees to cover the costs of DC Water's pretreatment oversight activities. The pretreatment group provides permitting, sampling and inspections for designated Industrial Users of the wastewater system. These pretreatment fees include annual permitting and monitoring fees for industrial users and a permit fee for wastewater trucked or hauled to Blue Plains. The current pretreatment rates and fees went into effect July 1, 2012. Fees were last updated in 2003. **Exhibit 4-9** lists various fees.

Exhibit 4-9: DC Water Pretreatment Rates and Fees

Industrial Permitting Fees		
Permit Initial Fee		$2,000
Permit Renew Fee		$600
Industrial User Annual Compliance Fees		
Significant or Non-Significant Categorical Industrial user		
	1 Outfall	$2,500
	2 or more Outfalls	$3,500
Significant or Non-Categorical Industrial user		
	1 Outfall	$2,500
	2 or more Outfalls	$3,500
Non-Significant or Non-Categorical Industrial user		
	1 Outfalls	$550
	2 or more Outfalls	$700

JMT reviewed the Annual Pretreatment Program Reports which are submitted to EPA by DC Water. The metrics reported by DC Water in the 2016 report (dated March 27, 2017) indicate 51 Significant Industrial Users (SIUs) with current Control Documents along with 55 facilities inspected in 2011. Enforcement metrics indicate active control by DC Water. DC Water reported one SIU in significant non-compliance for reporting discrepancies in 2016. The non-compliant SIU is located in the WSSC service area. JMT considers the pretreatment program to be managed and funded adequately. The coordination between the pretreatment programs at DC Water and the wholesale user agencies of the Inter-Municipal Agreement is compliant and timely.

4.3.4 CONDITION ASSESSMENT AND PLANNED IMPROVEMENTS

DC Water has assessed the Blue Plains facilities for conditions and rehabilitation needs. This information is used to initiate and/or prioritize projects within the 10-year rolling capital improvement plan (CIP). The 2018 Independent Consulting Engineer Assessment confirms the status of projects that have been completed and initiated since the 2013 Assessment. The following paragraphs below integrate information obtained during DC Water personnel interviews, site inspections by JMT engineering staff and the DC Water FY 2017 – FY 2026 CIP.

DC Water categorizes the capital projects at Blue Plains into four program areas:

- Liquid processing
- Plantwide
- Solids Processing
- Enhanced Nitrogen Removal Facilities

4.3.5 LIQUID PROCESSING PROGRAM

4.3.5.1 PRELIMINARY TREATMENT PROCESSES AND FACILITIES

The preliminary treatment process employed at Blue Plains includes:

- Raw wastewater pumping
- Screening
- Grit removal

Wastewater flow collected from parts of Maryland and Virginia suburbs is delivered to two raw wastewater pump stations (RWWPS1 and RWWPS2) by the Main (sometimes called Bolling) Outfall Sewer, the Potomac Combined Outfall, and the Potomac Sanitary Outfall sewers. Raw wastewater also enters the plant though the Upper and Lower Oxon Run sewers.

A system of interconnecting conduits ahead of the two pump stations (including the Equalizing Conduit inside the fence line) enables each station to receive its intended share of the total load. During preliminary treatment, incoming pumped raw wastewater is screened as it passes through coarse bar screens. Following screening, the wastewater is pumped to aerated grit chambers that accelerate the settling of grit for collection and disposal. While the heavier grit settles, lighter organic solids remain in suspension for removal later in the treatment process. Screened material and grit are collected and trucked to a permitted landfill for disposal. Following preliminary treatment, the effluent wastewater proceeds to primary treatment where more suspended solids and some BOD are removed.

The preliminary processes are split during dry weather between the east side and west side. During peak wet weather flows, the west side screens and grit removal facilities treat a constant 280 mgd, while the east side screens and grit removal facilities treat up to 780 mgd. Once the TDPS/ECF is operational, these processes will assume a less stressful and higher performing wet weather capacity split with the 225 mgd ECF, for a total plant capacity of 555 mgd for the first 4 hours of wet weather, with capacity for 511 mgd thereafter. This mode of operation provides a higher level of treatment to the wet weather discharge, made possible by the combined storage of the tunnel system and the added treatment capacity of the ECF.

Condition Assessment

During the intervening years between the 2013 Assessment and 2018 Assessment, DC Water completed numerous projects to rehabilitate and replace screening and grit removal. JMT inspected the preliminary treatment processes that have been upgraded and reviewed the on-going construction activities on March 2 and 5, 2018. The operational units are well maintained and performing within permit limits. **Exhibit 4-10** details the projects under construction:

Exhibit 4-10: Preliminary Treatment Processes and Facilities CIP Projects

Project ID	Project Title	Cost	Timeline
IZ	Replace/Upgrade Influent Screens	$81.2M	Completion FY 2032
OZ	Grit Chamber Building 1 & 2 – Upgrades	$15.2M	Completion FY 2028
UD	Raw Wastewater Pump Station #1 – Rehabilitate pumps and related pumping equipment.	$15.8M	Completion Expected Dec 2017
BC	Headworks Influent Structures	$12.1M	Completion FY 2023
BP	Structural and Architectural Upgrade of Grit Building (Phase II)	$0.5M	Completion FY 2019

Construction activities conform to DC Water standards and procedures.

4.3.5.2 PRIMARY TREATMENT PROCESSES AND FACILITIES

The primary treatment processes and facilities are designed and constructed to remove particles from wastewater by exploiting the differences in density between the particles and water. The primary treatment processes and facilities at Blue Plains include oils/grease/scum separation and primary sedimentation. Two separated primary treatment “trains” are in use at Blue Plains and are designated as the west side primary process and an east-side primary process, which total 36 primary sedimentation tanks.

Each tank is equipped with solids collection rakes to collect denser, settled wastewater solids. Scum skimming devices are used in each basin to collect the lighter, floatables from the wastewater surface. To enhance the settling properties of wastewater suspended solids, metal salts are added to enhance coagulation of suspended solids. Adding metal salts, such as Ferric Chloride, has the added benefit of precipitating phosphorous from the wastewater. Phosphorus removal is a requirement of the Blue Plains NPDES discharge permit.

Following primary treatment, the effluent is conveyed to the secondary treatment processes where biological processes reduce the BOD in wastewater. Primary solids (or sludge) settled in the primary sedimentation tanks are pumped to grit removal facilities. Following primary sludge degritting, the sludge is then pumped to the gravity thickeners and combined with other sludges produced throughout Blue Plains for treatment.

Condition Assessment

DC Water projects have been completed and are under construction for primary facilities. Additional projects are scheduled to start construction after 2018. These projects will continue to improve the condition of the primary sedimentation basins. **Exhibit 4-11** provides a tabular list of primary treatment projects and their status.

Exhibit 4-11: Primary Treatment and Facilities CIP projects

Project ID	Project Title	Cost	Timeline
I7	Primary Treatment 20-Yr Rebuild	$54.6M	Completion FY 2028
BQ	Primary Treatment Facilities Phase II	$33.7M	Completion FY 2023
B6	Primary Sedimentation Tank Covers	$43.6M	Completion FY 2028
B7	Primary Tank Odor Scrubbers	$45.9M	Completion 2032
J2	Replace/Upgrade Primary Treatment Mech.	$22.7M	Completion 2031

The Primary Treatment Processes and Facilities review was performed on December 19, 2017. There were no additional improvement needs identified and the existing facilities and equipment were operational. The structural repairs to the Sedimentation Basins (Project BQ) are structurally sound and larger, future structural rehabilitation work will provide on-going infrastructure stability.

Senior Blue Plains staff anticipates that the preliminary facilities will be in excellent operational order for the next 10-15 years in keeping with the CIP schedule.

4.3.5.3 SECONDARY TREATMENT PROCESSES AND FACILITIES

The secondary treatment facilities include:

- Step-feed Aeration Basins (Reactors)
- Activated Sludge Return System
- Secondary Blower Facility
- Secondary Sedimentation Basins
- Waste Sludge Pumping System

Secondary treatment begins as a biological wastewater treatment process that converts dissolved or suspended materials into relatively dense flocs that can be separated and settled from the water being treated. Blue Plains uses a modified-aeration step-feed activated sludge process that produces a wastewater mixed liquor that flows to the secondary sedimentation basins for settling and separation. Oxygen is supplied to each reactor to support growth of microorganisms which biologically act to consume suspended and dissolved wastes from the wastewater. The secondary treatment process is an important step to remove the majority of BOD and remaining suspended solids from wastewater to meet Blue Plains' NPDES Permit.

The secondary treatment process is divided into a west process train and an east process train, each receiving effluent from the respective west and east side primary sedimentation basin trains. The settled mixed liquor in the secondary sedimentation basins constitutes a sludge that is pumped to two different locations. A large percentage of the pumped sludge (activated sludge) is recycled back to the reactors with the goal to maintain a desirable concentration of microorganisms. The smaller, remaining percentage of sludge (waste sludge) is pumped to the plant's dissolved air flotation thickeners for treatment and disposal. See the section on Solids/Biosolids Treatment Facilities for a description of the solids treatment processes.

Condition Assessment

DC Water completed projects that remedied some of the structural and mechanical components of the secondary treatment facilities. **Exhibit 4-12** provides a tabular list of projects, which address the continual renewal of the secondary process.

Exhibit 4-12: Secondary Treatment Process and Facilities CIP Projects

Project ID	Project Title	Cost	Timeline
TO	Secondary Treatment Facilities – Structural rehabilitation of West basins 1-12, improvements to scum and solids collection equipment (all 24 basins), overflow troughs and weirs were replaced.	$70.6M	Completed FY 2016
PD	Secondary East & West Upgrade	$9.6M	Completion FY 2024
PE	Nitrification Reactor/Sediment Upgrades	$10.4M	Completion FY 2020

4.3.5.3.1 NITRIFICATION/DENITRIFICATION PROCESSES AND FACILITIES

The nitrification/denitrification processes and facilities enable the removal of biological nitrogen. Biological nitrogen removal is an aerobic process whereby bacteria convert ammonia nitrogen to nitrate nitrogen. Denitrification uses a different class of bacteria that thrives in an anaerobic environment and converts nitrite or nitrate ions to nitrogen gas bubbles. The bubbles attach to the biological flocs that buoy the floc to the surface of the secondary clarifiers.

Effluent from the secondary treatment process flows into a flow distribution basin at the head of the nitrification/denitrification reactors. Lime or sodium hydroxide is added to the distribution basin to maintain desired levels of alkalinity. The effluent is distributed to a set of 12 nitrification/denitrification reactors that are differentiated by odd/even numbering. Nitrification/denitrification is accomplished by a suspended growth biological system. Each of the 12 reactors has five stages; nitrification takes place in the first three stages and denitrification in the last two. The conversion of nitrate to nitrogen gas in the denitrification process requires methanol as a supplemental carbon source in the reaction. Turbine aerators in each stage of the reactors keep dissolved oxygen at desired levels and provide mixing to ensure uniform distribution of solids.

The mixed liquor from the nitrification/denitrification reactors flows to 24 sedimentation basins, also differentiated by odd/even numbering. Waste-activated solids that settle in the sedimentation basin are recycled back to the reactors to maintain optimal biological activity. Excess biological solids are pumped to the plant's dissolved air flotation thickeners for treatment and disposal.

Condition Assessment

DC Water has completed projects. **Exhibit 4-13** provides a tabular list of projects, which have improved the nitrification/denitrification facilities required to meet Total Nitrogen permit limits.

Exhibit 4-13: Nitrification/Denitrification Process and Facilities CIP

Project ID	Project Title	Cost	Timeline
E9 (TN/WW)	ENR Facilities Upgrades – Expands existing nitrification/denitrification facility for additional Biological Nitrogen removal.	\$272.8M	Completion FY 2020
BR	Nitrification/Denitrification Facility	\$52.0M	Completion FY 2023
BI	Enhanced Nitrogen Removal - North	\$75.1M	Completion FY 2020
E8	Enhanced Clarification Facilities	\$218.1M	Completion FY 2020
EE (TN/WW)	Centrate Treatment Facilities – de-ammonification of recycle sludge centrate stream.	\$108.5M	Completion FY 2021

The March 2, 2018 plant inspection reviewed the completed facilities and the operation and maintenance practices. The equipment was operational with no major repairs in process with respect to failed equipment. Housekeeping and safety conditions were excellent.

4.3.5.4 MULTIMEDIA FILTRATION AND DISINFECTION

The final stage of treatment for Blue Plains' effluent prior to discharge into the Potomac River is tertiary treatment comprised of filtration, disinfection, and chlorine removal. The treated plant flow is filtered through sand and anthracite in the world's largest wastewater filtration facility. The flow is disinfected with sodium hypochlorite-based chlorination at the filter influent, and the residual chlorine is removed before discharge with sodium bisulfite. The final plant effluent has the same basic parameters as drinking water with the exception that the disinfectant (chlorine) is removed as the flora and fauna within the river do not require the chlorine residual required for public drinking water systems.

The filtration process includes multimedia filtration of effluent from the nitrification and denitrification process. The filtration facility consists of 40 granular sand and anthracite filters. The final effluent filters are part of the process which allows Blue Plains to meet NPDES permit limits for phosphorous. Filters are routinely backwashed to remove clogging and solids from the filter media. Filter backwash is sent to the gravity thickeners for biosolids treatment.

The disinfection process begins in four disinfection tanks located beneath the 40 multimedia filters. Gaseous Chlorine is mixed with water and then injected into the disinfection tanks where sufficient contact time deactivates microbes. The disinfected water is then cleansed of the chlorine prior to discharge into the Potomac River.

DC Water will complete projects that would improve the Filtration and Disinfection facilities. These have been long term projects, first reported in the 2008 Assessment. **Exhibit 4-14** provides a tabular list of the two on-going Filtration and Disinfection projects.

Exhibit 4-14: Filtration and Disinfection CIP Projects

Project ID	Project Title	Lifetime Cost	Timeline
UC	Filtration and Disinfection Facilities upgrades influent pumps and installs a new air-water backwash system along improved backwash automation. This project has been continued based on results of concrete structures reliability study.	$101.8M	Completion FY 2022
BT	Filtration and Disinfection Facilities (Phase II) – provides new electrical building and electrical switchgear and appurtenances.	$25.0M	Completion FY 2022

Condition Assessment

The facilities were visited on March 2, 2018. Construction material was observed being stored adjacent to the large facility. The visit, during extreme wind conditions, showed that stored material was being protected from the elements.

4.3.6 SOLIDS HANDLING PROCESS

4.3.6.1 SOLIDS/BIOSOLIDS TREATMENT FACILITIES

4.3.6.1.1 PRIMARY SLUDGE SCREENING, GRIT REMOVAL AND GRINDING

Primary sludge from the West and East Sedimentation processes is pumped through screens to remove rags and debris from the sludge prior to the grit removal facility.

Condition Assessment

DC Water is planning a project to improve operations of the Primary Sludge Screening, Degritting and Grinding facilities as reported in the 2013 Assessment. **Exhibit 4-15** provides more information on the project.

Exhibit 4-15: Primary Sludge Screening, Degritting and Grinding CIP Project

Project ID	Project Title	Cost	Timeline
YZ	Digestion Facilities Site Preparation – Sub-project YZ01 – Primary Sludge Screening and Degritting Wet Well Control – Installation of new controls for primary sludge screens and degritting and grinding facility wet well.	$2.3 M	Completion FY 2019

The current state of the Primary Sludge Screening, Degritting and Grinding was inspected and no improvement needs were observed or discussed during an interview and site visit on March 2, 2018.

The existing Primary Sludge Screening, Degritting and Grinding has remained in service for both of the biosolids treatment and disposal systems: the Cambi Hydrolysis Process and the back-up Lime Stabilization process.

4.3.6.1.2 GRAVITY THICKENERS

The gravity thickeners (GT) accept primary sludge from the screened and thickened sludge from the primary clarifiers. The primary sludge enters a central distribution chamber that distributes the sludge among GTs in operation. Each GT provides volume and residence time to allow the sludge to settle and thicken. Each thickener is equipped with a collector mechanism that pushes the thickened sludge toward a central well where the sludge is collected and pumped to the raw sludge blending tanks. Peripheral weirs and troughs collect clarified water from the surface of the thickeners and discharge it to the primary sedimentation effluent.

Condition Assessment

DC Water has completed projects that improved the GTs within the interceding years since the 2013 report. Capital Project BX, Gravity Thickener Upgrades Phase II, has been expanded to rehabilitate and upgrade the Primary Sludge Screening & Degritting Building (PSSDB) and the Gravity Thickeners (GT). There are ten GTs. The lifetime cost of Project BX has increased to $70.8M and is scheduled to be completed FY 2036.

The GTs are performing well within the solids train to the Cambi system for digestion. The rehabilitated GTs are well maintained.

4.3.6.1.3 DISSOLVED AIR FLOTATION THICKENERS

Blue Plains has eighteen (18) flotation thickeners operationally arranged in groups of three or four units fed from a common splitter box. The dissolved air floatation (DAF) thickeners thicken biological waste activated sludge from the secondary sedimentation basins and the nitrification/denitrification sedimentation basins. The DAF's also thicken scum from primary sedimentation and gravity thickening processes. Thickened sludge, oils and grease is pushed into a receiving wet well by collectors where pumps convey it to the sludge blending tanks.

DAF thickeners are used to thicken biological sludges and oils/grease that are less dense and more difficult to settle. They use a process of injecting fine bubbles into the influent sludge, the bubbles adhere to the suspended matter, causing the suspended matter to float to the surface. The "froth" layer containing sludge and oils/grease is then removed by a skimmer. Clarified water passes beneath a baffle and is recycled to the wastewater treatment process.

Condition Assessment

DC Water has completed a project that has improved the DAF Thickeners. This project is summarized in **Exhibit 4-16**.

Exhibit 4-16: DAF Thickeners CIP Project

Project ID	Project Title	Cost	Timeline
XB	Biological Sludge Thickener Facility Upgrades – Project reduces sludge processing and chemical costs. Also, handle additional sludge produced by new nitrification/denitrification processes.	$48.7M	Completion FY 2018

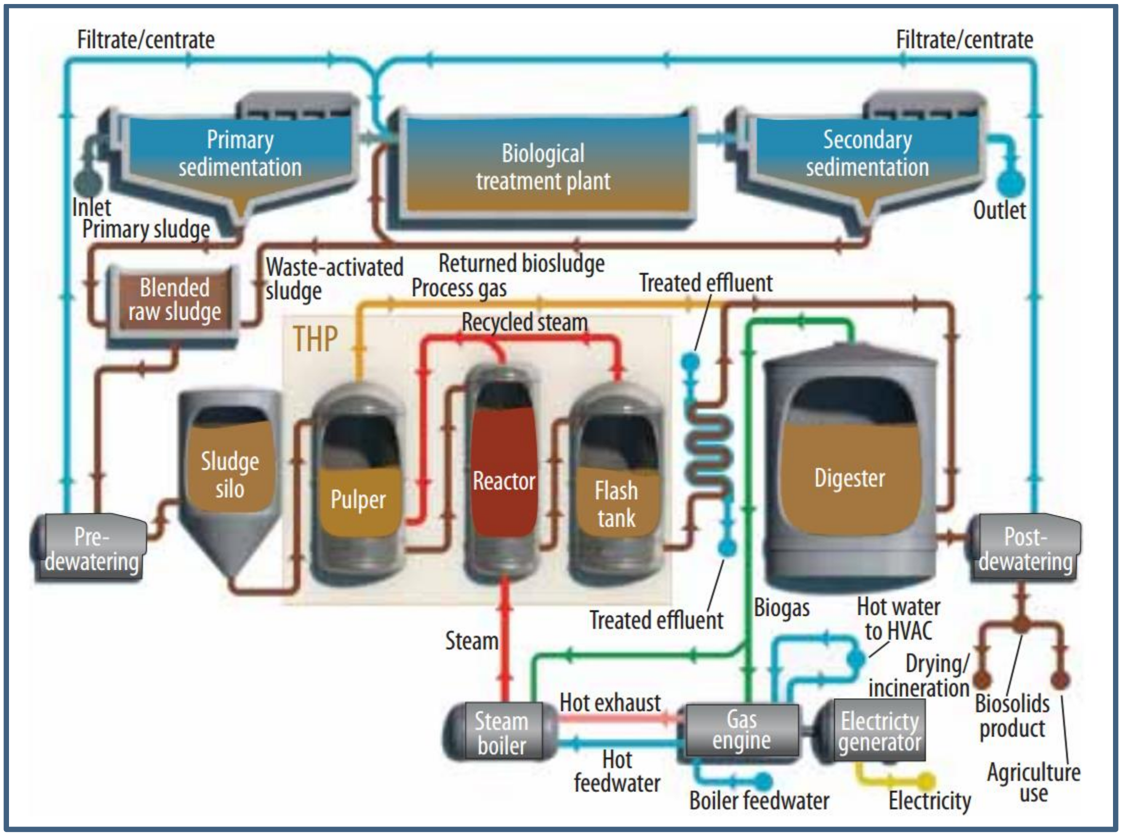
The DAF facilities were inspected on March 2, 2018. As with the entire solids handling train, the facilities are operational and well maintained. Odor controls are working and maintained on a scheduled routine.

In the past, three DAF thickeners were used to thicken nitrification/denitrification sludge while the remaining units were used to thicken secondary waste activated sludge. Recently, Blue Plains AWTP has implemented a new single-stream processing scheme that reduces supplemental carbon (Methanol) injection for denitrification. The new scheme simplifies the process by sending nitrification/denitrification sludge to the secondary aeration basins. This reduces supplemental carbon (Methanol) by taking waste nitrifying/denitrifying bacteria, inserting them into the carbon-rich secondary aeration basins and giving them a “head start” to remove Nitrogen from the wastewater. The secondary sludge, plus any nitrification/denitrification sludge settled in the secondary sedimentation basin, and then continues to the DAF Thickeners for thickening.

4.3.6.1.4 SLUDGE DIGESTION FACILITIES

The Walter F. Bailey Bioenergy Facility, which is now operational, significantly reduces DC Water’s carbon footprint. The innovative Cambi® thermal hydrolysis process uses intense heat and pressure to treat wastewater solids producing a much cleaner biosolid and onsite generation of up to one third of Blue Plains’ electricity needs. This process has resulted in operational efficiencies in electricity, biosolids hauling and chemicals costs. The upgraded process nearly eliminates the need for lime sludge stabilization. The process produces Class A Biosolids that expand disposal and reuse options. DC Water maintains the lime stabilization process that produces Class B biosolids as a redundant process for reliability in processing biosolids. **Exhibit 4-17** illustrates the Cambi Thermal Hydrolysis process.

Exhibit 4-17: Typical Cambi® Thermal Hydrolysis Process



This process has provided DC Water with significant cost savings associated with biosolids treatment and disposal. The sources of cost savings are listed below:

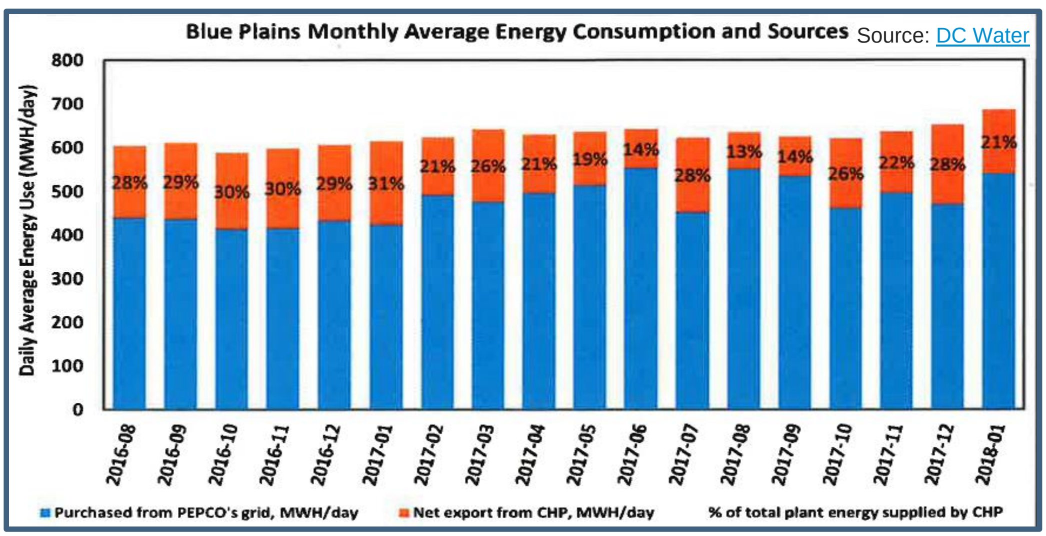
- Digester Gas (140 million BTU/day) produced by this process is used to create steam (Pepco Energy Services process on-site at Blue Plains) applied to influent sludge that destroys pathogens and enhances digestion and solids reduction.
- Excess digester gas produced can be used to produce up to 13 MW of electricity that can be used to supplement Blue Plains electricity needs.
- DC Water can burn outside supplied natural gas with digester gas, when natural gas rates are competitive, and sell the electricity to Pepco.
- Sludge volume reduction has resulted in significantly reduced hauling costs.
- Class A Biosolids are marketed as Bloom®, a soil amendment (pictured), which recovers solids handling costs through product sales.
- Savings associated with the Cambi Process is expected to exceed operational and debt service costs, although this report did not conduct a cost/benefit analysis.

Condition Assessment

The facilities are in good operational order and are well maintained. Operations and maintenance staff have been trained on the new facilities.

Performance of the Combined Heat and Power (CHP) facility is closely monitored by DC Water managers and the board. **Exhibit 4-18** has been taken from the Environmental Quality and Operations Committee's February 15, 2018 report.

Exhibit 4-18: Blue Plains Monthly Average Electric Energy Consumption and Sources



DC Water is completing the CHP project and is scheduled for completion in FY 2020. **Exhibit 4-19** discusses the summary details of that project.

Exhibit 4-19: Sludge Digestion CIP Project

Project ID	Project Title	Cost	Timeline
XA	New Sludge Digestion (Cambi) Facilities – Installation of 4 new Cambi Thermal Hydrolysis trains, new sludge digesters, new sludge screening facility, belt presses/truck loading and modifications to existing sludge blending tanks to enhance flexibility of feed sludge to Cambi System.	$551.5M	Completion FY 2020

4.4 COLLECTION AND CONVEYANCE

DC Water collects and conveys separate and combined wastewater to Blue Plains for treatment. This includes wastewater generated by jurisdictions included in the IMA, the Potomac Interceptor Agreement (PIA) and Loudoun Water. Wastewater conveyance systems include: sanitary sewers and combined sewers and nine sewer pumping stations. In 2016, the first section of an elaborate and sophisticated wet weather storage tunnel system was placed in service that will convey wet weather sewage to Blue Plains. DC Water is responsible for operating, maintaining and making improvements to sewer lines serving the District of Columbia and the major trunk sewers that convey wastewater from the IMA, PIA and Loudoun Water served communities.

4.4.1 SEWER FACILITIES PLAN

The 2015 Sewer System Facilities Plan was prepared for DC Water by the Engineering Program Management Consultant. The report's ***"Notes to Readers"*** states:

This Facilities Pan provides a comprehensive evaluation of the DC Water sewer system infrastructure, which provides collection and treatment for the District of Columbia, and treatment for parts of suburban Virginia and Maryland. This Facilities Plan focuses on DC Water's sewer system pipeline network, pumping stations, sewer structures, inflatable dams, and outfalls, and presents a strategy for improvements that will enable DC Water to extend the service life of its sewer system. This Facilities Plan:

- Outlines the current status of the DC Water sewer system.
- Provides an update of the sewer system inventory.
- Identifies infrastructure improvement needs.
- Presents recommendations for the current operation of the system.

This 2018 Assessment evaluated the efficacy of the Facilities Plan and the measures taken by DC Water to implement the plan.

4.4.2 SEWER COLLECTION

DC Water collects wastewater from the District, covering 61 square miles. Separate storm water and sanitary collection systems account for 41 square miles, while a combined storm water and sanitary sewer collection system covers 20 square miles.

The following lists DC Water's collection system characteristics in numbers:

- 41 square miles of separate sewage
- approximately 1,800 miles of sanitary and combined sewers
- 22 permanent flow metering stations
- 20 square miles of combined sewage
- 125,000 building laterals
- 1810 – year sewer system began construction

Like most utilities around the country, DC Water is responsible for lateral sewer connections from the main sewer to the right-of-way/property lines regardless of the property owner. For large water and sewer users, DC Water meters each wholesale customer. Each wholesale customer permit/agreement establishes discharge limits with respect to the average wastewater flow rate and peak wastewater flow rate. Sewers constructed 50 years ago or more were constructed of vitrified clay, brick, and concrete. More recent, separated sewer installations use PVC, ductile iron, and concrete for sewer construction. The force mains are typically constructed of iron, steel, or concrete.

DC Water continues to use the services of an EPMC to manage projects improving the sanitary sewer system. The mission of the EPMC is to determine sewer system condition, confirm system capacity and develop new capital projects. A condition and criticality assessment of sewers will result in the most urgent repairs and rehabilitation taking place first. In turn, this has resulted in efficient and prioritized use of DC Water money and resources.

The condition of the aged sewer system is typical for a system of this size and age. Because many sewers date back to the late 1800s, DC Water will need to continually invest in repair, replacement, and rehabilitation. An average of $51.3M per year will be spent on sewer system improvements over the next 10 years as presented in the FY 2017 – FY 2026 Disbursement Plan. Projects in the CIP are indicative of DC Water's efforts to keep the system in good operating condition. Discussions with management indicate a high level of productivity in conjunction with the Asset Management Program initiative that should continue to yield efficiencies in this area of business operations. Asset Management is discussed in Section 3.6.8.

The 2015 Sewer System Facility Plan

This plan is the result of in-depth study of the existing collection facilities, which included sewer inspections and condition assessments, development of a GIS database, and hydraulic monitoring and modeling to determine system capacity. Due to time and budgetary constraints, DC Water has limited inspections to sewers identified as critical due to their location, tendency to be problematic, and criticality in the system.

Sewer conditions were assessed using the National Association of Sewer Service Companies' (NASSCO) defect coding system. Uniform and consistent descriptions of pipe defects were accomplished using the Pipeline Assessment Certification Program (PACP).

This 2018 Independent Engineer's Review agrees with the Facilities Plan's findings that though the sewer pipe infrastructure is sufficient to meet current and future demands, investment and upgrades to the system are needed.

Targeted performance measures identified and reported in DC Water's FY2018 Operating Budget indicate that Sewer Services has been meeting their goals. Since 2008 approximately 28,000 catch basins have been cleaned annually, 2,200 laterals have been investigated/relieved annually, 424 tons of floatable debris have been removed from the river annually, 365 sewer lateral have been repaired or replaced annually, 1,900 linear feet of sewer mains have been replaced annually, and 400 PI meters have been inspected. However, this productivity could not be verified within this assessment. JMT recommends establishing the appropriate metrics to track preventive measures against corrective maintenance needs. As discussed in Section 3.6.8, Asset Management, DC Water has transitioned from corrective maintenance to an effective proactive maintenance being implemented and performed by a highly motivated staff. This was apparent through the various interviews conducted over the winter of 2017-2018 as part of this assessment and in earlier contacts with DC Water personnel during the years between reports.

4.4.3 COLLECTION SYSTEM CIP

DC Water has undergone a comprehensive risk assessment of linear assets to prioritize rehabilitation projects. The Sanitary Sewer programmed improvements are categorized into five components:

- Collection Sewers
- On-Going
- Pumping
- Program Management
- Interceptor/Trunk Force Sewers

Collection Sewers projects include studies and projects to effectively eliminate stormwater, groundwater, and other infiltration and inflow to the sewer system; to separate stormwater flows; and to reduce other extraneous flows to Blue Plains. This category also includes projects to rehabilitate sanitary sewer pipes. On-going replacement projects include replacements managed by the force account work performed by Department of Sewer Services.

The FY 2017 – FY2026 10-Year Disbursement Plan totals $104.8M for collection sewers under 20 structures rehabilitation projects. On-Going projects account for $104.1M within 14 active fiscal year projects.

4.4.4 INTERCEPTOR/TRUNK FORCE SEWER

The aging infrastructure concern is paramount in the interceptor, trunk, and force mains within urban areas and the District's original sewers are no exception. Due to their roles within the sewer system, these pipes are often critical assets, with vulnerabilities and risks greater than those of a typical sewer pipe. The ten-year disbursement identified in the 2015 Sewer Facilities plan for FY 2017 – FY 2026 totals $228.0M. The significant project is LZ – Potomac Interceptor – Rehab Phase 2. This regional interceptor is funded mainly by other jurisdictions with 3.29% funded by DC. The ten-year disbursement for LZ is $38.6M. Project JI – Oxon Run Sewer rehabilitation has $14.0M allocated within the CIP. The Piney Branch Trunk sewer has $16.8M allocated.

4.4.5 PUMPING FACILITIES

Nine pump stations convey wastewater to Blue Plains. These pump stations are listed in **Exhibit 4-20**. The 3rd and Constitution pump station is currently out of service.

Exhibit 4-20: Wastewater Pumping Stations

Facility	Date Installed	Installed Capacity
Main	1905	300 mgd (Sanitary) 480 mgd (Stormwater)
Poplar Point	1915	64.8 mgd
Rock Creek	1921	60 mgd
Earl Place	1926	0.86 mgd
O Street	1963	60 mgd (Sanitary) 600 mgd (Stormwater)
Potomac	1965	576mgd
East Side	1967	60 mgd
Upper Anacostia	1970	15 mgd
3rd and Constitution (out of Service)	1983	7.85 mgd

The combined pumping capacity of these pumping stations is approximately 1150 million gallons per day. The pumping stations are sized to handle both sanitary and combined sanitary and stormwater flows.

A number of pump stations have recently been upgraded. These upgrades were done in part to meet new code standards and regulations. The improvements have boosted the efficiency and effectiveness of the pump stations.

DC Water has completed major pumping station upgrades during the interceding report years. Two significant upgrades to sewer pumping stations remain active projects. **Exhibit 4-21** lists the remaining upgrades:

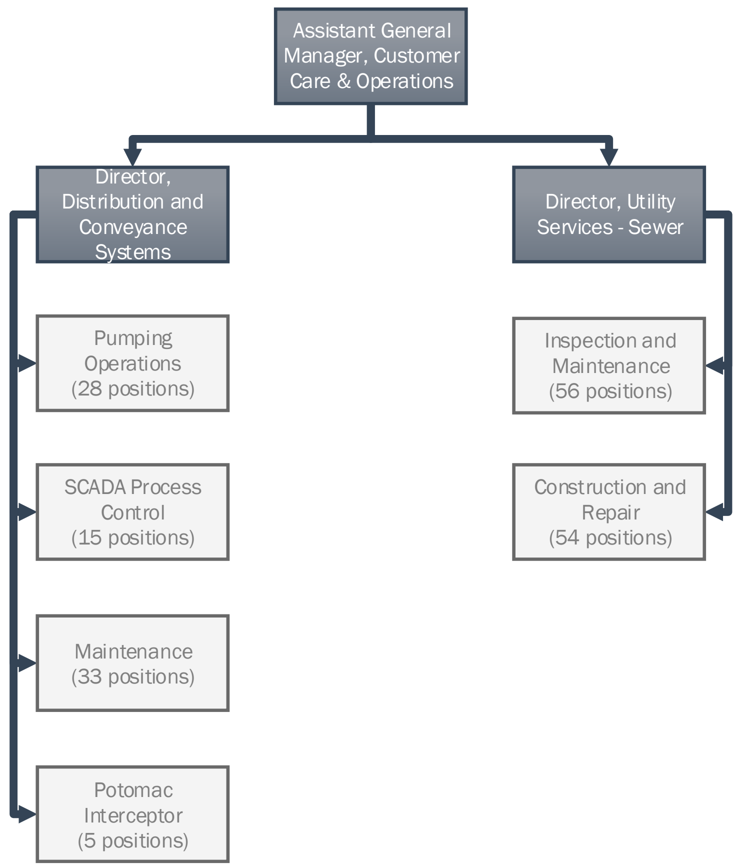
Exhibit 4-21: Sewer Pumping Facilities

Project ID	Project Title	Cost	Timeline
MB	3rd St & Constitution Ave NW PS	$7.4M	Completion FY 2021
PM	East Side Pumping Station	$4.0M	Completion FY 2022

4.4.6 DEPARTMENT OF SEWER SERVICES (DSS)

During the years between independent reporting, DSS was reorganized. The pumping station (conveyance) responsibilities were combined with the Water System's pumping station and storage facilities responsibilities. This separate department is the Department of Distribution & Conveyance Systems. The organizational structure of these departments is presented in **Exhibit 4-22**.

Exhibit 4-22: Sewer Services Organization Chart



DSS is currently responsible for the inspection and maintenance of the sewers and sewer laterals. Another major responsibility is the construction and repair of sewer mains and stormwater appurtenances. The managers of DSS were interviewed on February 6, 2018 and provided a comprehensive review of operations and maintenance metrics according to the Enterprise Asset Management Plan discussed in Section 3.6.8. DSS employs technologies within the inspection of underground linear assets and performs construction activities using various trenchless technologies that minimize at grade disruptions within the District's R.O.W.s and easements. Presently, DSS is located on the O Street property and plans are progressing for relocating DSS to new, modern facilities at Ames Place within the District.

Condition Assessment

Confined spaces were not entered for this assessment; however, the general at-grade conditions for large trunk sewers were inspected during various inspections within the District. B Street/NJ Avenue and Tiber Creek trunk sewers did not display signs of failure. The frailty of the aging arched sewers was prominent in discussions with staff and the proper monitoring of conditions is occurring. Earlier in the intervening years, the Piney Branch Trunk sewer was evaluated by JMT and the CIP addresses the appropriate rehabilitation.

4.4.7 DEPARTMENT OF DISTRIBUTION & CONVEYANCE SYSTEMS (DDCS)

DDCS is responsible for both water and sewer facilities. The sewer pumping station and wet weather conveyance responsibilities are addressed in the organizational chart presented in Section 4.4.6. Interviews and site inspections occurred in March 2018 and previously during the interceding years. Preventive maintenance for both vertical and linear assets is the responsibility of DDCS. SCADA has improved as funded by earlier capital projects and the Instrumentation and Controls section is well-trained and motivated. New monitoring responsibilities for the Combined Sewer Overflow facilities, which are scheduled to be commissioned at the end of March 2018, have been assimilated into DDCS's operations and maintenance. The Potomac Interceptor is operated and maintained by DDCS, along with the metering, odor control, and easement stewardship for the asset along its alignment in Maryland and Virginia.

4.4.7.1 MAIN & O STREET PUMPING STATIONS

Built in 1905, the Main Pumping Station pumps from the Tiber Creek and B Street/New Jersey Avenue, which includes flows from the Potomac/Rock Creek system that enter the B Street/New Jersey Avenue Trunk Sewer, to Blue Plains under the Anacostia River. The pump station has an installed capacity of 300 mgd for sanitary sewer and 480 mgd for stormwater. Firm capacity (with the largest pump out of service) is 240 mgd and 400 mgd for sanitary and stormwater respectively.

The O Street Pumping Station, built next to the Main Pumping Station in 1963, is designed to pump flows to Blue Plains. One side of the facility pumps storm water while the other side is dedicated to sanitary pumping. The pumps allocated to sanitary flow pump wastewater from the Southwest Interceptor, whereas the stormwater side pumps combined flow from the B Street/New Jersey Avenue Relief Sewer to the Anacostia River. Currently the construction of the new Administrative Headquarters building is occurring at the pumping station. Access is being properly controlled for operations and maintenance staff to perform duties. The Main and O Street Pumping stations have had major construction for the Clean Rivers Project for seven years and DC Water has been adept at coordinating new construction in and around existing facilities without major disruptions occurring.

Condition Assessment

Field inspections were performed for Potomac PS, Main and O Street PSs, and East Side PS. The stations are well maintained and, as earlier stated, capital projects have rehabilitated the stations with the East Side PS scheduled for additional upgrades to facilitate more efficient operations. SCADA equipment is well maintained at all stations and safety equipment is present and operable.

4.4.7.2 UPPER ANACOSTIA PUMPING STATION

The Upper Anacostia Pumping Station (UAPS), built in 1934, has an installed capacity of 15 mgd and a firm capacity of 10 mgd. The UAPS was not inspected and was recently rehabilitated.

4.4.7.3 POTOMAC PUMPING STATION

The Potomac Pumping Station, placed in service in 1963, has an installed capacity of 576 mgd and a firm capacity of 460 mgd. Wastewater from the Potomac/Rock Creek system is pumped via force mains under the Anacostia River to Blue Plains. The Potomac Pumping Station was recently upgraded. Improvements included, among other items, replacement of existing screens and gate valve actuators.

4.4.7.4 EASTSIDE PUMPING STATION

The Eastside Pumping Station, brought on line in 1967, has an installed capacity of 60 mgd and firm capacity of 45 mgd. This station separately pumps wastewater from the Eastside Interceptor Sewer and transports the material removed by the Northeast Boundary Swirl Facility. As part of the CIP, the Eastside Pumping Station was replaced FY 2009. No operational deficiencies were observed in March 2018.

4.5 STORMWATER

4.5.1 STORMWATER BACKGROUND

The stormwater sewer system consists of approximately 8,200 catch basins, 600 hundred miles of storm sewers, over 400 separate storm sewer discharge points, and fifteen stormwater pumping stations; some of the stormwater sewer facilities exceed 100 years old. DC Water is responsible for maintenance and replacement of several combined stormwater and sanitary sewer facility discharge points on the Potomac River, Anacostia River, Rock Creek and other water courses in the District.

In 2000, U.S. EPA Region III issued a Municipal Separate Storm Sewer System (MS4) Permit to the District of Columbia Government for management of the separate storm sewer system. DC Water was designated the lead agency responsible for coordination of permit compliance activities with the D.C. Departments of Public Works and Health. Since inception of the District Department of Energy and Environment (DDOEE), the District of Columbia’s separate stormwater system has been regulated by an EPA MS4 permit that ensures compliance with the Clean Water Act. The goal of the MS4 stormwater NPDES permitting program is to improve the quality of stormwater discharged to water bodies. Currently, stormwater permits have specific requirements for control and monitoring of discharges from industrial and construction sites. Some of the results from the MS4 include an Anacostia TMDL Compliance Plan and the Rock Creek TMDL Compliance Plan estimated at approximately $7 million per year to meet all the requirements of the permit.

Although DC Water has reduced responsibility for the separate stormwater system other than collecting fees and transferring those fees to DDOEE, DC Water continues to support other agencies (e.g. DDOT) that participate in the MS4 taskforce and monitors the impact of other MS4 NPDES requirements on DC Water and its ratepayers. DC Water continues to operate and repair stormwater pumping stations at underpasses.

4.5.2 STORMWATER PROJECTS

Stormwater projects are categorized into six components within the CIP:

- Local Drainage
- On-Going
- Pumping Facilities
- DDOT
- Research and Program Management
- Trunk/Force Sewers

The Ten-Year Disbursement Plan (FY 2017 – FY 2026) totals $23.0M. The Lifetime costs total $84.0M.

Selected stormwater CIP projects are listed below in **Exhibit 4-23** displaying lifetime costs:

Exhibit 4-23: Stormwater CIP Projects

Project ID	Project	Cost	Schedule
	Stormwater Local Drainage	$22.8 M	
• **A6** • **GY** • **IE**	• Lining, 22nd & P Sts., NW • Storm Rehab @ Various Locations • Storm Sewer Rehabilitation 3		• Completed FY 2015 • Completion 2020 • Completion 2026
	Stormwater On-going Projects	$12.4 M	
Various FY Programs	DSS Stormwater Projects		Completion FY 2016 – FY 2026
	Stormwater Pumping Facilities	$25.0 M	
NG	Pump Station Rehab		N/A
	DDOT Stormwater Projects	$3.2 M	
Various FY Programs	DDOT projects		Completion FY 2017 – FY 2019
	Stormwater Research and Program Management	$12.0 M	
AT	Stormwater Program Management		Completion FY 2025
	Stormwater Trunk/Force Sewers	$15.6 M	
BO	Future Stormwater Projects		Completion FY2020

4.5.3 STORMWATER OPERATIONS AND MAINTENANCE

DSS inspects, cleans, installs, and repairs the 8,200 catch basins and storm mains associated with the combined sewers. DSS oversees the maintenance program for stormwater structures, filter bio-retention and water quality and catch basins.

During the DSS managers' interviews on February 6, 2018, a comprehensive review of the asset management records was conducted. The productivity metrics were highly valued by staff. DSS has undergone an analysis of their catch basin cleaning protocols, discovering that mechanical cleaning is more efficient and environmentally sound than comparable flushing and vacuuming methodologies and equipment favored throughout the industry. The capturing of the debris and sediment is more complete and doesn't cause a flushing of material downstream while cleaning the catch basin. A major drawback to vacuuming is the depth of many catch basins, which negate the ability to maintain suction to vacuuming equipment. This is anecdotal to DC Water's overall approach to operational research and development, which provides innovation to the water and wastewater industry.

4.5.4 FINDINGS

DSS approaches stormwater management responsibilities in a professional manner. The environmental aspects of their mission and O&M protocols are a source of pride. Productivity levels are steady and meet the stipulated requirements.

SECTION 5 CLEAN RIVERS PROJECT

5.1 OVERVIEW

DC Water entered into a Consent Decree with the EPA in March 2005 for the Combined Sewer Overflow Long Term Control Plan (CSO-LTCP). The objective of the 2005 Consent Decree is to ensure DC Water's compliance with the Clean Water Act, all applicable federal and local regulations, the terms of DC Water's National Pollution Discharge Elimination System (NPDES) permit, and the 1994 EPA CSO objectives. To meet these objectives the Consent Decree contains compliance requirements, milestone and completion timelines, and reporting requirements. The requirements included in the consent decree and their current statuses are summarized below in **Exhibit 5-1**. In the interceding 12 years between the establishment of the CSO-LTCP and the present, DC Water has achieved a majority of the milestones and has aggressively pursued the planning, financing, design and construction of the remaining requirements in accordance with the multi-year schedule for the CSO-LTCP. The modified Consent Decree discussed in Section 5.2 has placed more emphasis on Green Infrastructure (GI) to meet the goals of the CSO-LTCP.

Exhibit 5-1: Status of Clean Rivers Compared to Amended LTCP Consent Decree (As of March 8, 2018)

Amended Consent Decree Item	Requirements	Status
System Wide		
Low Impact Development – Retrofit (LID-R)	Implement LID-R projects on WASA facilities where feasible.	Complete
Anacostia River		
Rehabilitate Pumping Stations	Rehabilitate existing pumping stations: • Rehabilitate Main Pumping Station to 240 mgd firm sanitary capacity. • Rehabilitate Eastside and 'O' Street Pumping stations to 45 mgd firm sanitary capacity	Complete
Storage/Conveyance Tunnel from Blue Plains to CSO 019	Minimum 105 million gallon storage tunnel between Blue Plains and CSO 019	Constructed, to be placed in operation March 23, 2018
Northeast Boundary Storage/Conveyance Tunnels	Storage/Conveyance Tunnel in Northeast Boundary and First Street Branch Tunnel in area of First Street NW and Rhode Island Ave. The total system storage of these tunnels and Storage/Conveyance Tunnel from Blue Plains to CSO 019 shall not be less than 157 million gallons.	First Street Tunnel is completed and Northeast Boundary Tunnel is under construction
M Street (CSO 016 and 017) and CSO 018 Diversion Sewers	Consolidate the following CSOs in the Anacostia Marina area: CSO 016, 017 and 018	Complete
Separate CSO 006	Separate this CSO in the Fort Stanton Drainage Area	Complete
Poplar Point Pumping Station	Replace the existing Poplar Point Pumping station with a new facility	Constructed, to be placed in operation March 23, 2018
Rock Creek		
Separate Luzon Valley	Separation was completed in 2002	Complete
Separation	Separate CSOs 031, 037, 053, and 058.	Complete
Monitoring at CSO 033, 036, 047 and 057	Conduct monitoring to confirm prediction of overflows. If overflows confirmed, then perform the following: <u>Regulator Improvements</u>: Improve regulators for CSO 033, 036, 047 and 057	Complete
Rock Creek Green Infrastructure Project 1	Control 20 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	In progress

Amended Consent Decree Item	Requirements	Status
Rock Creek Green Infrastructure Project 2	Control 75 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	Not started
Rock Creek Green Infrastructure Project 3	Control 90 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	Not started
Rock Creek Green Infrastructure Project 4	Control 90 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	Not started
Rock Creek Green Infrastructure Project 5	Control 90 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	Not started
Potomac River		
Rehabilitate Potomac Pumping Station	Rehabilitate station to firm 460 mgd pumping capacity	Complete
Potomac Storage Tunnel	30 million gallon storage tunnel for CSO 020, 021, 022 and 024	NEPA documentation and Facility Planning underway
CSO Outfall Separation	Separate CSO 025 and 026	Not started
Potomac Green Infrastructure Project 1	Control 44 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	In progress
Potomac Green Infrastructure Project 2	Control 46 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	Not started
Potomac Green Infrastructure Project 3	Control 43 impervious acres to the 1.2" retention standard using green infrastructure and targeted sewer separation	Not started
Blue Plains Wastewater Treatment Plant		
Wet Weather Treatment Improvements	Tunnel Dewatering Pumping Station and Enhanced Clarification Facility	Constructed, to be placed in operation March 23, 2018

The CSO-LTCP is a component of the overall Chesapeake Bay Program. DC Water (along with many other wastewater agencies within the Chesapeake Bay region) is required to improve wastewater treatment facilities and remediate combined wastewater system overflows to prevent BOD and nutrient rich wastewater from entering tributaries of the Bay. The improvements by DC Water (and other nutrient contributors) prevent these nutrients from entering the Bay. When a CSO event occurs, harmful bacteria and pollutants are released into the water system. The pollutants include floatable debris, BOD and nutrients loads which can negatively impact the river, decreasing the dissolved oxygen content, raising turbidity, and lowering the water quality. The aesthetics of the river are affected by floating debris and algae blooms cause by the nutrient loads.

The TN/WW Plan, as stated in Section 2 of this report, is a highly complex undertaking at Blue Plains. The CSO-LTCP and the TN/WW Plan are linked in the goal of increasing water quality in the Chesapeake Bay watershed. The CSO-LTCP has been modified to appropriately address the overall goals. The organizational structure of the program management for the CSO-LTCP was enhanced several years into the Consent Decree by DC Water.

The creation of the DC Clean Rivers Project (DCCR) placed the CSO-LTCP efforts directly under the DC Water Chief Engineer and enhanced public outreach and participation by providing a transparent organization. DCCR has a visible profile within the community and the DCCR team is highly motivated in pursuing the completion of the components remaining in DCCR.

The DCCR and TN/WW Plan combined efforts are summarized as:

- DC Clean Rivers Project: $2.6 Billion
- Nitrogen Removal: $950 Million
- Total > $ 3.5 Billion
- 25-year implementation (2005 – 2030)
- 96% reduction in CSOs & flood relief in Northeast Boundary
- Approximately 1 million lbs/year nitrogen reduction predicted

5.2 CONSENT DECREE MODIFICATIONS

On January 14, 2016, the Court entered the First Amendment to the CD (Amended CD) in Consolidated Civil Action No. 1:CV00183TFH. The Amended CD incorporates changes to the selected CSO controls to substitute Green/Gray CSO Controls in the Potomac sewershed and Green CSO Controls in the Rock Creek sewersheds. The Amended CD also extended the time for implementation of the controls from 20 years to 25 years (to 2030). The Amended CD requires DC Water to construct the first Green Infrastructure (GI) project in the Potomac and in Rock Creek, to perform post construction monitoring for one year and then to determine the practicability of GI. If GI is determined to be practicable, then DC Water will construct the remainder of the GI projects. If GI is determined to be impracticable, DC Water is required to construct gray controls.

5.2.1 GREEN/GRAY CSO CONTROLS

5.2.1.1 POTOMAC SEWERSHED

The Green/Gray CSO Controls in the Potomac sewershed are designed to build upon the additional conveyance and treatment capacity provided by the Blue Plains Tunnel, the Tunnel Dewatering Pump Station (TDPS), and the Enhanced Clarification Facility (ECF). DC Water will construct Green Infrastructure (GI) and perform targeted sewer separation to treat 1.2” of rainfall over 133 impervious acres in the Potomac sewershed to control CSO outfalls 027, 028, and 029 prior to 2027. For Outfalls 020, 021, 022 and 024, a smaller 30 million gallon Potomac storage tunnel will be constructed. Outfalls 025 and 026 will be controlled by sewer separation. After the first project is completed, DC Water will evaluate the Potomac GI plan based on constructability, operability, efficacy, public acceptability and cost effectiveness. Based on this evaluation, if GI is determined to be impracticable for control of CSO 027, 028, and 029, the Potomac Tunnel will be extended to control these CSOs, and the Potomac tunnel’s storage capacity will be increased to 40 million gallons.

5.2.1.2 GREEN/GRAY CSO CONTROLS FOR THE ROCK CREEK SEWERSHED

DC Water will substitute Green Infrastructure (GI) for the Piney Branch Storage Tunnel. DC Water will construct GI and perform targeted sewer separation to treat 1.2” of rainfall over 365 impervious acres in the Rock Creek sewersheds to control CSO 049 prior to 2030. After the first project is completed, DC Water will evaluate the GI plan based on constructability, operability, efficacy, public acceptability and cost effectiveness. Based on this evaluation, if GI proves impracticable after the first project, DC Water will construct a 9.5 million gallon gray storage facility in lieu of GI to control this CSO.

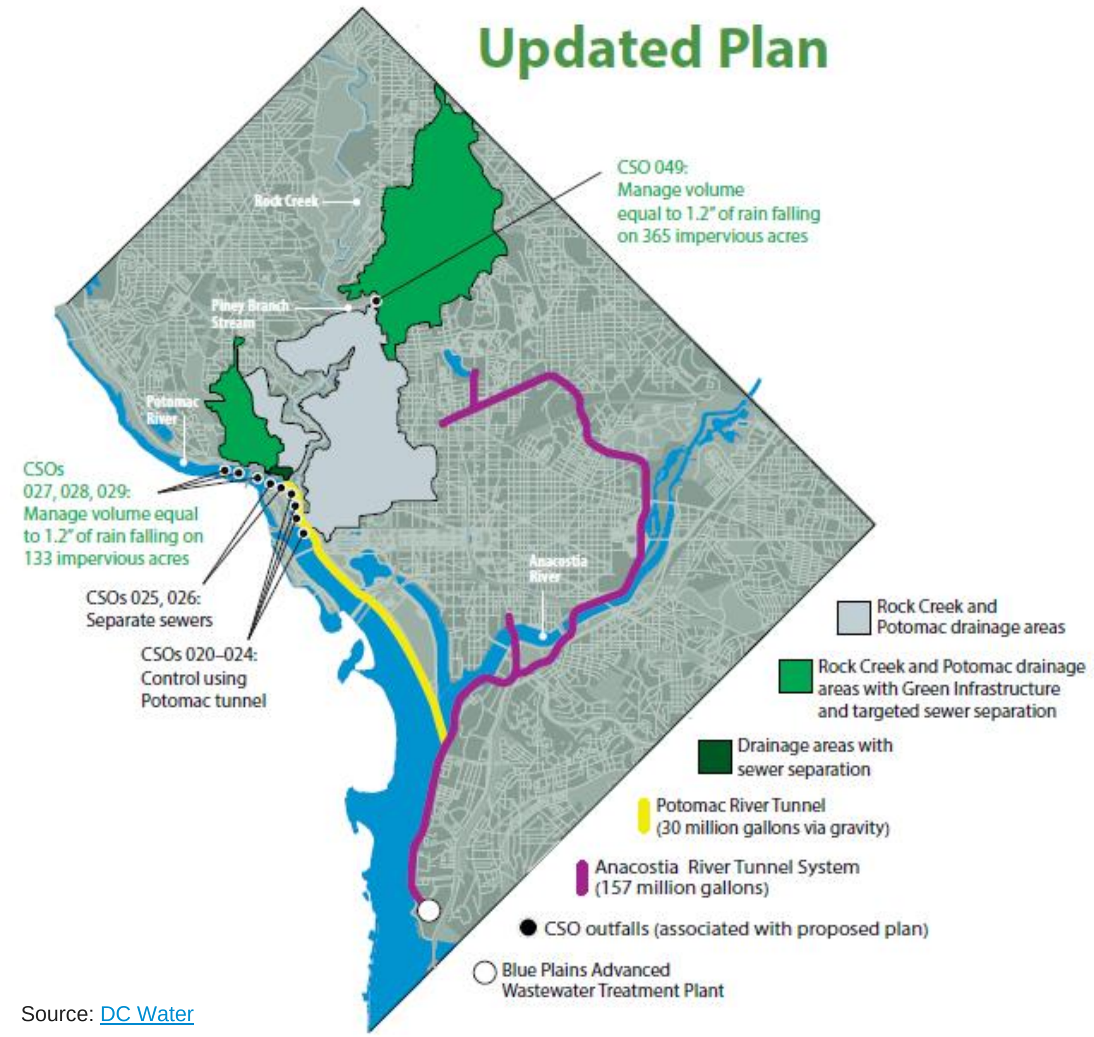
5.2.2 AMENDED TOTAL NITROGEN LIMIT

In addition to substituting GI for gray controls, the Amended CD incorporated controls required to achieve a new total nitrogen effluent limit for Blue Plains of 4.689 million pounds per year. The total nitrogen limit was developed by EPA to achieve the goals of the Chesapeake Bay Total Maximum Daily Load (TMDL) for nutrient reductions. The TN/WW Plan incorporates these major components:

- Complete treatment capacity – Blue Plains will provide complete treatment up to 555 mgd for the first four hours and 511 mgd thereafter.
- Enhanced nitrogen removal (ENR) – ENR facilities will be constructed with capacity to provide complete treatment for the flow rates identified above and to meet the new total nitrogen effluent limit.
- Enhanced Clarification Facility (ECF) – A 225 mgd facility will be constructed at Blue Plains.
- Tunnel to Blue Plains and System Storage Volume – A new tunnel is being constructed from Poplar Point to Blue Plains. The total tunnels system storage volume will be increased from 126 MG to 157 MG. This new tunnel segment will not only serve as a flow equalization facility but will also allow a reduction in the required capacity of the ECF and the peak flow rates that receive complete treatment at the Plant
- Tunnel Dewatering Pumping Station (TDPS) – Under the Final LTCP, a tunnel dewatering pumping station was proposed to be constructed at the tunnel terminus at Poplar Point. As part of the TN/WW plan, the same tunnel dewatering pumping station is relocated to the new terminus of the tunnel at Blue Plains. The TDPS will be sized to have a minimum firm capacity of 225 mgd, equal to the capacity of the ECF. In addition, the facility will have the ability to dewater the tunnel system up to the new ECF and be able to discharge ECF effluent to complete treatment and discharge at Outfall 002 or at Outfall 001.

A map of the amended plan is presented in **Exhibit 5-2**.

Exhibit 5-2: Updated Plan

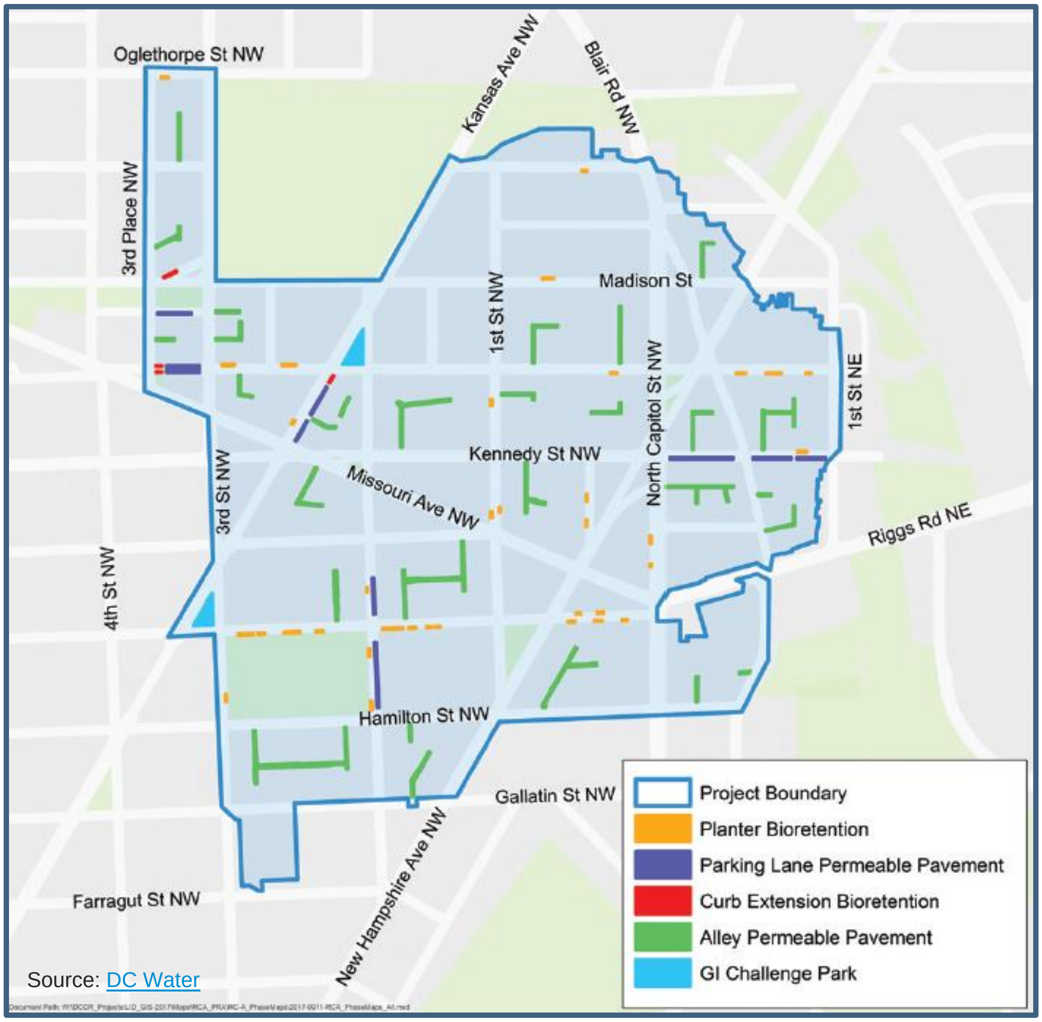


Source: DC Water

5.2.3 GREEN INFRASTRUCTURE PROJECTS

During the summer of 2017, DC Water began construction of Rock Creek Project A, its first large-scale GI project aimed at significantly reducing CSOs in the Rock Creek sewersheds. **Exhibit 5-3** shows the extent of this project. Construction of Rock Creek Project A is expected to complete in 2018. DC Water is also anticipating work to begin in 2018 on a second large-scale GI project, Potomac River Project A, aimed at addressing CSOs in the Potomac River sewershed. Potomac River Project A design is complete, and the project is on track for completion in 2019. The GI technology components of these projects include bioretention on planter strips and curb extensions, permeable pavement on streets and alleys, and downspout disconnection, including rain barrels. A summary of these technologies is provided in the following paragraphs.

Exhibit 5-3: Rock Creek Green Infrastructure Project A



Source: [DC Water]

5.2.4 GREEN INFRASTRUCTURE PRACTICES

Bioretention generally consists of a pooling or ponding basin where runoff accumulates until it absorbs naturally into the soil, preventing, or significantly reducing runoff and contributing back into the natural hydrologic cycle. Bioretention also generally incorporates a planted vegetation component and a filtration media, such as mulch, at a minimum. The vegetation serves several purposes, as it slows and retains the water runoff until it can absorb, while also mobilizing water through evapotranspiration, another key component of the natural hydrologic cycle. The mulch assists in removing any pollutants from stormwater, reducing pollution that is contributed through stormwater back into the local aquifers and waterways.

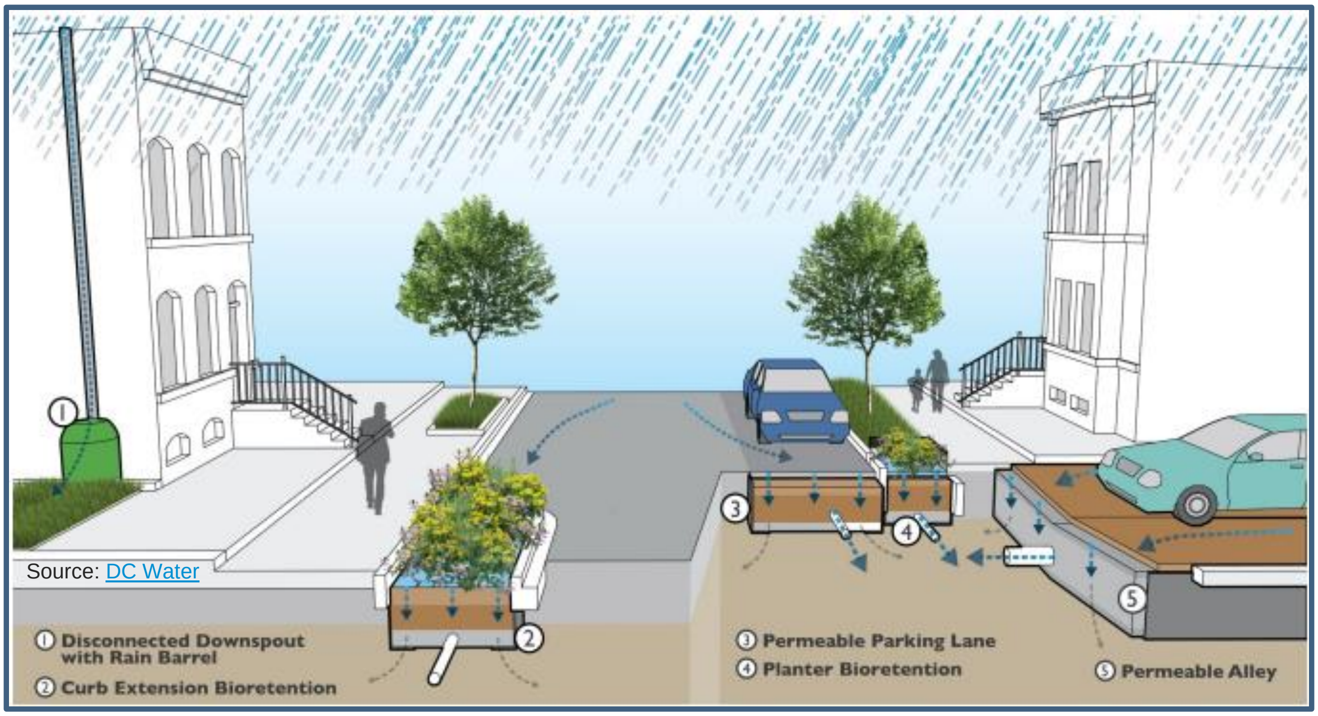
Permeable pavements function similarly to bioretention, allowing the stormwater to absorb into the ground surface beneath the pavement, while maintaining a hardscape that is necessary in urban environment, such as alleys, sidewalks, and parking lots. In graded applications, the permeable pavement designs incorporate check dams to increase the retention and infiltration of the stormwater over the surface area.

Downspout disconnection is the practice of disconnecting building downspouts from interconnection with the combined sewer system, instead discharging the rainwater over a vegetated area or retaining it temporarily in a rain barrel. Rain barrels will retain rain water between storms allowing users to water lawn and garden plantings without use of metered water, saving costs.

Other green infrastructure practices employed by DC Water in these projects include landscape infiltration gaps, grated boardwalk crossings, recessed landscape planters, among other sustainable practices. These practices generally seek to avoid impervious surfaces, maximizing areas where stormwater can be naturally absorbed.

Examples of various GI practices are illustrated in **Exhibit 5-4**.

Exhibit 5-4: Green Infrastructure Examples



Source: DC Water

In DC Water's applications, infiltrative GI practices such as bioretention and permeable pavements are tied to underdrain systems that convey excess stormwater from the GI practices back to the combined sewer system. This reduces the risk of flooding in GI areas during significant storm events (greater than the designed 1.2") due to retention. DC Water uses sewer flow monitoring to quantify the reduction of stormwater contribution to the CSO system by the GI practices.

5.2.5 GREEN INFRASTRUCTURE INNOVATION AND PUBLIC-PRIVATE COOPERATION

DC Water has hosted cooperative design challenges for several green infrastructure projects within the Rock Creek area. These challenges have engaged the private sector to yield innovative modern designs that incorporate concentrated GI practices into useful public spaces. An example is the challenge park design presented as **Exhibit 5-5**.

Exhibit 5-5: Green Infrastructure Challenge Park Design

Source: DC Water

5.2.6 STRATEGIC PARTNERSHIPS

To enhance its effectiveness in completing GI projects, DC Water has also pursued strategic partnerships with public agencies holding jurisdiction over the public spaces where GI practices will be implemented in the District. An example is the Green Alley Partnership with the District Department of Transportation (DDOT), the District's public space steward. Additionally, DC Water has effectively partnered with permitting agencies to enhance its ability to obtain permits and quickly mobilize to achieve the goals of the GI projects and Clean Rivers.

5.2.7 OPERATIONS AND MAINTENANCE

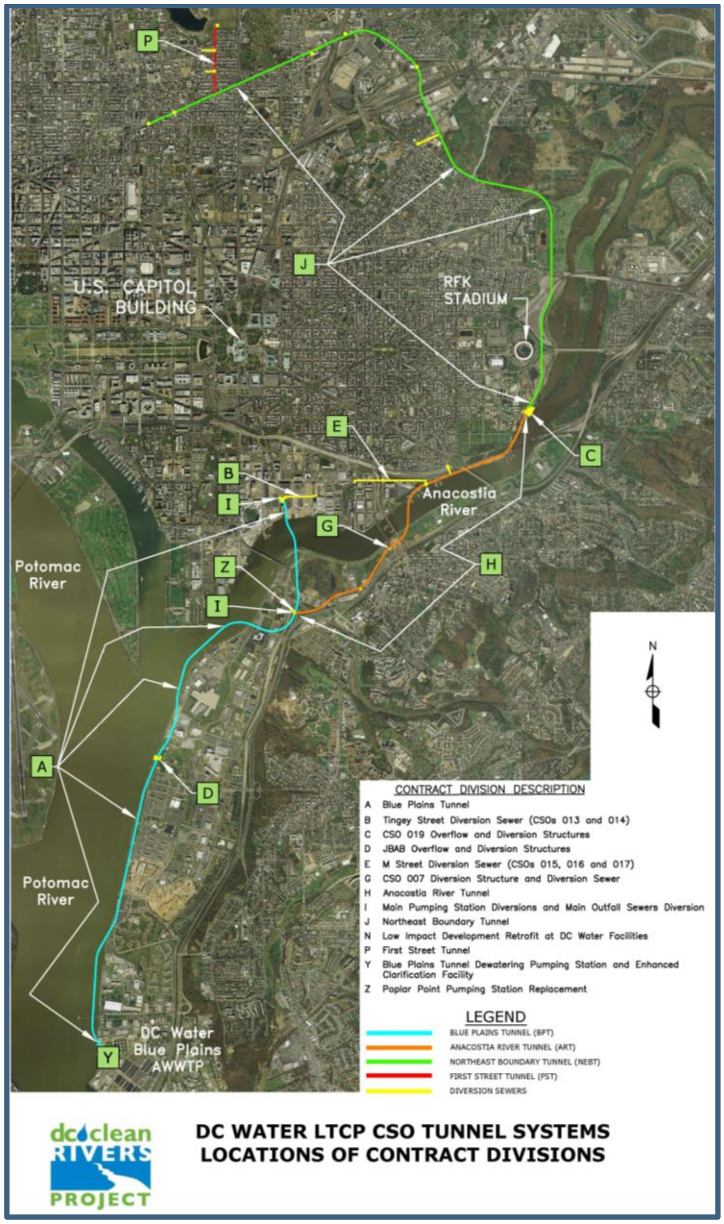
In addition to its efforts toward constructing the GI practices, DC Water has placed a high priority on the ongoing maintenance requirements of GI after the installation. DC Water has developed and procured the operations and maintenance expertise necessary to ensure the ongoing success of GI practices on a large scale. Additionally, GI maintenance is being managed through Maximo, DC Water's enterprise asset management software. Through Maximo, routine maintenance is set and then routinely will be assigned on the assigned schedule. DC Water is applying an adaptive management approach to its implementation of GI. Analytics will be applied to the results of O&M and the overall GI practices. Future iterations will be adjusted or enhanced as needed account for any noted deficiencies.

5.3 PROJECTS

DC Water Clean Rivers projects include a variety of improvements within the combined sewer system within the District. Similar to 750 cities across the United States, Washington DC has a combined sewerage system that allows a mixture of storm water and sewage to overflow into the Anacostia and Potomac Rivers and Rock Creek when it rains. The first phase of the Clean Rivers Project plan focused on reducing combined sewer overflows into the Anacostia River by constructing major elements of the Anacostia River Tunnel (ART) System. A large portion of the Anacostia River Tunnel System is to be commissioned (placed in service) by March 23, 2018 and on schedule to meet the Federal Consent Decree requirements which DC Water currently has with USEPA, DOJ and the District.

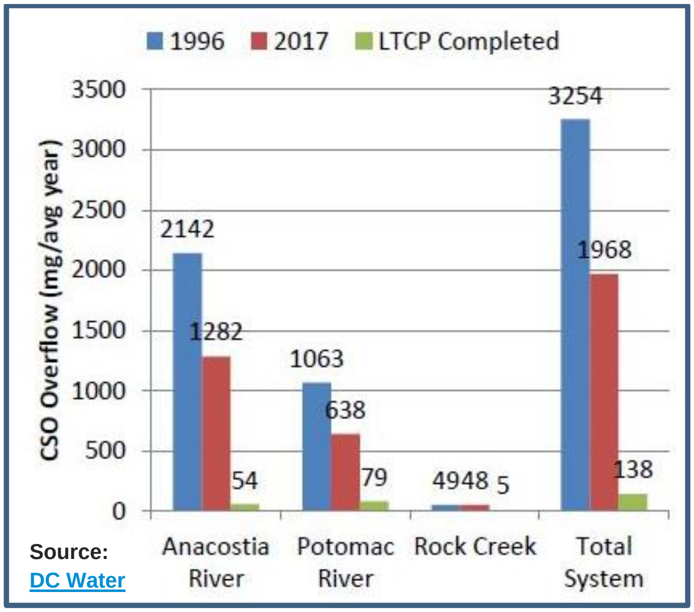
The FY 2017 – FY 2026 CIP identifies the lifetime budget of the Clean Rivers Project as $2.76 billion. **Exhibit 5-6** shows the Anacostia River Tunnel System designated by divisions and these designations will be used in this section of the report. All ART work from Divisions C to Y will be placed into service by March 23, 2018.

Exhibit 5-6: Tunnel System and Contract Divisions Map



Progress through 2017 is represented by **Exhibit 5-7**, indicating the reduction in the annual combined sewer flow in the watersheds. Exhibit 5-3 includes the measured effect of Green Initiatives to date (2017) and the projected results upon completion of the CSO-LTCP.

Exhibit 5-7: Volumetric CSO per Annum

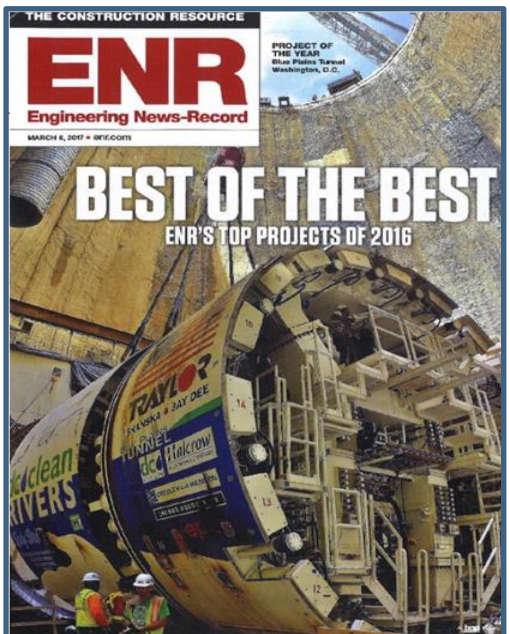


Source: DC Water

5.3.1 CONTRACT DIVISIONS

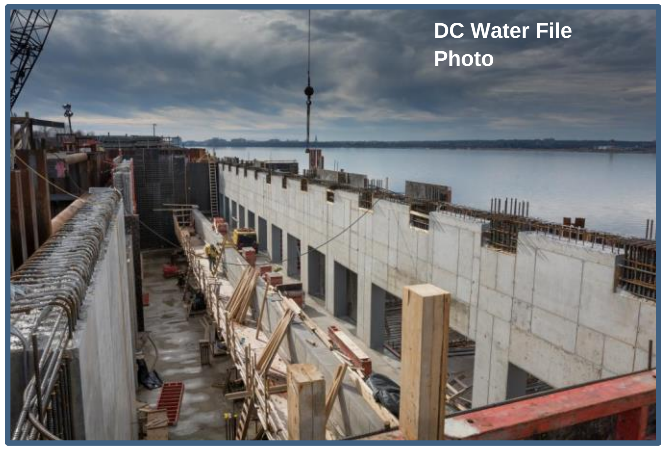
5.3.1.1 BLUE PLAINS TUNNEL (DIVISION A)

The Blue Plains Tunnel (BPT) was the first (and hydraulically at the lowest datum) to be constructed. A more detailed description of the tunnel is in the 2013 Assessment. The project has received several awards and was a successful design/build contract, which established a culture of design/build within DC Water. The BPT will be placed in service on March 22, 2018. On March 5, 2018, JMT inspected the tunnel's conclusion at Blue Plains (the tunnel dewatering pump station), which was being operationally tested prior to the upcoming commissioning.



Cover of ENR Magazine, March 6, 2017 - Lady Bird TBM Launch

5.3.1.1.1 DIVISIONS D & Z



Division D (Div. D), JBAB Overflow & Diversion Structure is a new CSO constructed to divert excessive storm surges in a controlled manner. The new structure allows the demolition of the existing CSO 003. The structure incorporates a scenic overlook for the personnel on the joint military base.

Div. D provides the following:

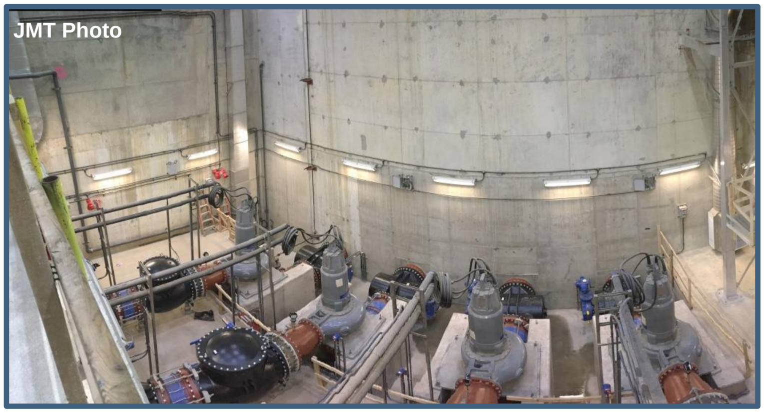
- Divert flow from the existing Potomac Outfall Sewers through a new diversion chamber located on JBAB and convey the diverted flow into the BPT through a shaft constructed by the BPT contract.
- Provide new hydraulic internals within the shaft constructed by the BPT contract
- Provide an overflow from the BPT through a new overflow structure on the bank of the Potomac River adjacent to the BPT.
- Demolish an existing overflow - CSO 003 - and abandon its outfall pipe. These facilities are located on JBAB and District property south of the new diversion and overflow facilities.
- Install instrumentation at various facilities on other Anacostia River Project contracts and at new sites.
- Start-up Services include a variety of work that is required to place diversion, instrumentation and other facilities constructed under Division D and other contracts in service and coordination with other contracts as to the timing, sequencing and testing required for start-up of the Anacostia River Projects.

Division Z (Div. Z) is the new Poplar Point Pumping Station (PP-PS) constructed to provide the following services:

- New 55 mgd Poplar Point Sewage Pumping Station (PP-PS):
- Divert flow from the existing Anacostia Main Interceptor (AMI) via the proposed AMI Diversion Chamber (AMI-DC) and direct diverted flow through the proposed AMI Diversion Sewer (AMI-DS) to the Emergency Overflow Structure (EOS);
- Convey dry weather flows from the EOS to the newly constructed PP-PS where the flow will be lifted and conveyed via a 42" diameter force main to the location of discharge into the gravity sewer system at the proposed Discharge Connection Chamber (DCC);
- Provide conveyance of sewage from the sewer collection system located in Barry Road to the EOS via the Barry Road Sewer Extension (BRSE);
- Provide wet weather overflow from the EOS to the Poplar Point Junction Shaft (PP-JS) and the underlying Blue Plains Tunnel (BPT);
- Provide a wet weather overflow from the Main Outfall Sewers (MOS) through the proposed MOS Diversion Chamber (MOS-DC) to the BPT via an approach channel and a vortex drop structure currently under construction in DCCR Division A;
- Provide access to the newly constructed PP-PS from the northbound lane of South Capitol Street;
- Provide parking, vehicular movement area, drainage, landscaping and other site amenities to the proposed PP-PS site;
- Provide start-up and operational training services for the newly constructed PP-PS.

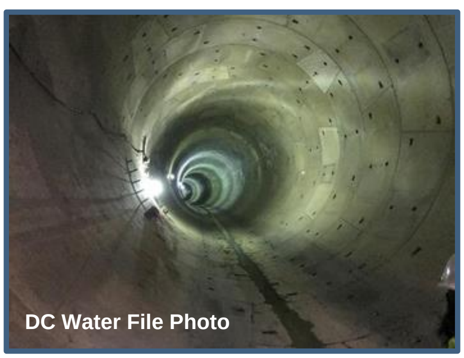
The existing pumping station will be decommissioned when Div. Z is complete. Although PP-PS is a wastewater conveyance asset, this project is incorporated into the DCCR based on the Poplar Point Junction Chamber and Shaft being the confluence structure for the Blue Plains Tunnel and Anacostia River Tunnel. This structure incorporates local sanitary and storm water to overflow into the BPT via a drop shaft. The PP-PS conveys wastewater conventionally within the CSO system during dry weather conditions.

Condition Assessments


JMT Photo

Division D was not inspected due to security restrictions at the Joint Base Anacostia Bolling. Div. Z was inspected on March 2, 2018. PPPS remains under construction. The construction contractor is behind schedule. This condition is atypical of DCCR construction projects. It does highlight the proactive and solution-focused corrective actions of DCCR. The project challenges were differing site conditions, limited site confined by highway traffic, and interruption by pumping operations during wet weather, and competition for labor in an expanding economy. The CRP mitigated the impact by increasing communications with the contractor, implementing a 2nd shift, focusing more resources on identifying better methods and scheduling efficiencies, and also assuming project work by the Program Consultant Organization (PCO) to avail Div. Z of expertise gained from the overall DCCR. The March 2nd inspection saw evidence of the increased efforts by DCCR. Safety measures were in place and operational testing was being performed.

5.3.1.2 ANACOSTIA RIVER TUNNEL (DIVISION H)


DC Water File Photo

The Anacostia River Tunnel (ART) is the continuation upstream of the BPT. As completed, the ART is a 12,500-linear foot, 23-foot diameter tunnel that starts at the drop shafts (north and south) located at CSO 019 (adjacent to RFK Stadium), the ART's discharges to the Blue Plains Tunnel - Poplar Point Drop Junction Chamber. The ART is approximately 100-feet below the surface.

Like the BPT, the ART stores and conveys excess combined storm and sanitary wastewater during and following a wet weather event preventing these excessive flows from inhibiting treatment at the treatment plant and protecting the Anacostia River against pollution from CSO events. The BPT and ART have combined storage capacity of approximately 100 million gallons.

The ART tunnel includes four intermediate drop shafts (aside from the two terminal drop shafts) that convey wet weather overflows from surface CSO combined sewer pipes down to the ART. These shafts may also serve as an emergency overflow to the Anacostia River in rare storm event when the ART and BPT are overwhelmed.

- CSO 018 Diversion
- CSO 007 Drop Shaft (Div. G)
- M Street Drop Shaft (Div. E)
- CSO 005 Drop Shaft (Div. G)

CSOs - 015, 016, 017, & 018 have been bulk-headed and are no longer active outfalls. Other diversion facilities are incorporated in the tunnel design for major storm events.

Condition Assessments

5.3.1.2.1 M STREET DIVERSION SEWER SITE (DIVISION E)

All operational work at CSOs 015, 016, and 017 Diversion Facility sites has been completed. Minor site restoration work remains.

5.3.1.2.2 CSO-018 DIVERSION FACILITY

This site is operationally complete. During the assessment tour, a mobile crane, a small manhole chamber, and recently delivered stop logs were on site. DCCR personnel were up-to-date on the status of the installation of the stop logs for the March 23, 2018 commissioning of the diversion. This site mainly awaits aesthetic work such as completion of the bridge’s stone work and landscaping.

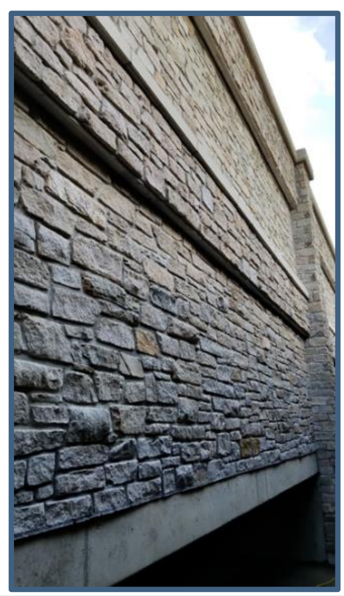
5.3.1.2.3 CSO-007 DROP SHAFT (DIVISION G)

The CSO 007 diversion was constructed several years ago by the 11th Street Bridge design/build team. The site remains an active construction site and is secured as such.

5.3.1.2.4 CSO-005 DROP SHAFT (DIVISION G)

CSO-005 is a completed facility on federal property and operationally ready for the tunnel commissioning.

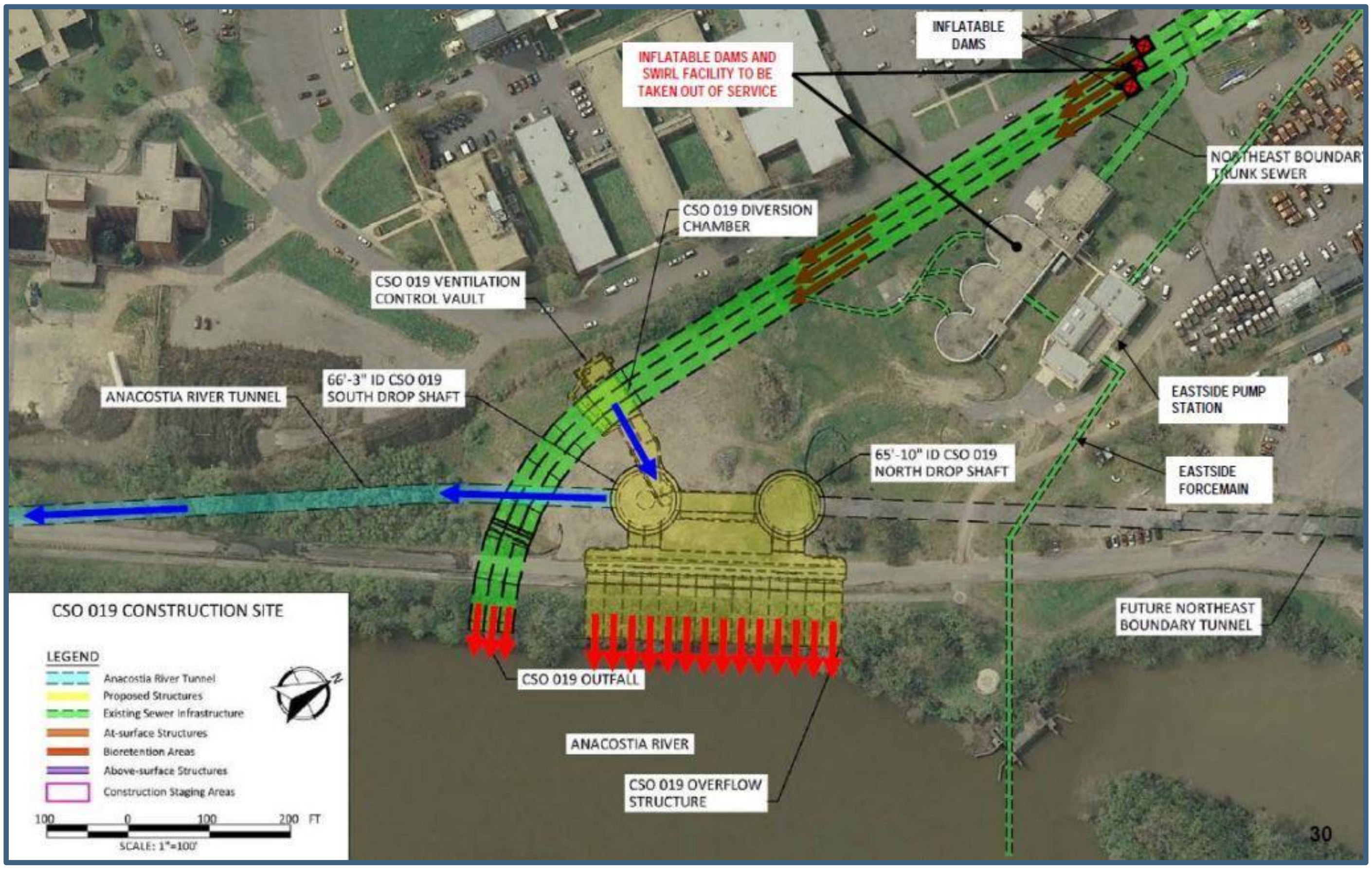
5.3.1.3 CSO-019 OVERFLOW AND DIVERSION STRUCTURE



CSO-019 is a large overflow structure designed to dampen the impact of diverted flows to the Anacostia River. The 120-yard width allows the diversion to have a limited exit velocity to the Anacostia River, which is a flow normal (perpendicular) to the river’s flow. Constructed on National Park Service lands, the structure is architecturally compatible with the Anacostia Riverwalk Trail (pictured at right).

The tunnel/CSO schematic is included in this 2018 report. This area of construction is currently the largest active construction as the ART and CSO-019 are brought on line March 22, 2018. The upstream Northeast Boundary Tunnel (NEBT) is awaiting the arrival of the refurbished tunnel boring machine (TBM) to commence the tunneling portion from the north drop shaft currently under construction. **Exhibit 5-8** shows the layout of the CSO – 019 facilities that are under construction.

Exhibit 5-8: CSO – 019 Improvements (Ongoing)



Condition Assessment

CSO-019 is complete and the ground restoration and the landscaping on National Park Service lands conform to the overall Anacostia Riverwalk Trail. The at-grade access hatches and hardscaping blend well with the riverbank pedestrian and vehicular traffic byways.

5.3.1.4 NORTHEAST BOUNDARY TUNNEL (DIVISION J)

The Northeast Boundary Tunnel (NEBT) is DC Water's largest project to date and is the largest component of DCCR. The NEBT is a large, deep, sewer tunnel that will increase the capacity of the existing sewer system in the District, significantly mitigating sewer flooding and improving the water quality of the Anacostia River. The NEBT comprises 27,000 feet of 23-foot diameter soft ground tunnel ranging in depth between 80 and 160 feet. The project also includes: seven deep shafts; five diversion chambers; seven adits; several storm water inlets; two ventilation control vaults; one 80,000cfm above ground ventilation control facility, constructed near Amtrak Yard; and two 3,000cfm below grade ventilation control facilities. The overall project will have 11 construction sites.

The NEBT will connect with the First Street Tunnel and Anacostia River Tunnel to provide a complete gravity system from Northwest DC to Blue Plains Advanced Wastewater Treatment Plant, where all flows captured by the tunnel system will be delivered for treatment prior to discharge to the Potomac River. Completion is scheduled for 2023. Once the NEBT is connected to the other Clean Rivers tunnels, combined sewer overflows to the Anacostia River will be reduced by 98 percent. In addition to controlling combined sewer overflows, the construction of the Northeast Boundary Tunnel will reduce the chance of flooding in the areas it serves from approximately 50 to 7 percent in any given year.

The NEBT design/build contract was awarded in July 2017 and the Notice to Proceed (NTP) issued in September 2017. The $580M contract amount is within the $500M - $600M estimated cost range in the 2013 edition of this report. This most recent procurement was during an expanding economy not experienced during the previous tunnel procurements. JMT reviewed the evaluation and selection process. Clean Rivers evaluated the design/build bidders' technical proposal prior to opening the price proposals. The awarded contractor possessed the highest technical score and had the lowest price bid. The Multi-Jurisdictional Cost Allocation is projected to be 7.1% of the NEBT contract. The cost allocation may be revised subsequently to this report.

Condition Assessment

The NEBT construction site is the upper portion of the CSO-019 site and is the junction of the ART & NEBT. This site was very active with many levels of above and below grade activity with machinery and labor forces on the surface. There is still about a month of site demobilization and restoration (clean-up, landscaping and hardscaping) associated with the south drop shaft. The exposed concrete covers to the ART shaft were being covered with impermeable membranes; however, this work only requires a few days effort.

5.3.1.4.1 NORTH SHAFT

The North Shaft is being prepared for the launching of the Tunnel Boring Machine (TBM), northerly, to mine the NEBT. Essentially the same Design/Build contractor team (except change of design engineer) was awarded the work for the ART and the NEBT work. This facilitated the 'hand-off' from one contractor on-site to another contractor starting work on the identical ground. This allowed bypassing the inefficient efforts of restoring the South Drop Shaft (ART) and then excavating the North Drop Shaft (ART) sites under two separate contracts.

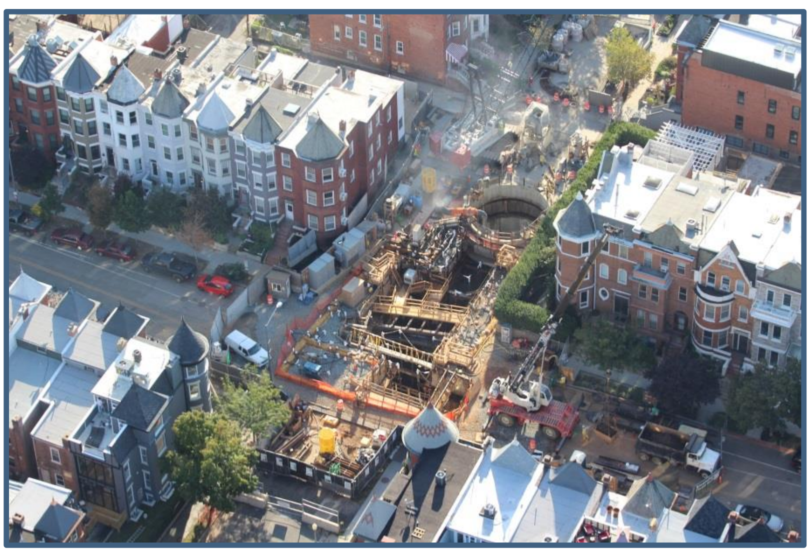
During the interview with the Clean Rivers staff, the Director explained Clean Rivers' practice of having the exiting design/build team for one division contract negotiate with the arriving team on the adjoining division contract. The negotiated hand-off eliminates site restoration to fulfill a specification of site conditions at the end of one contract and assumed by the bidders for the next contract. The hand-off is approved by Clean Rivers after the contractors agree on site conditions (and intra-costs) at the hand-off. This eliminates unnecessary work, which is required for Design-Bid-Build contracts and adds Risk Management concerns on the owner (DC Water.)

The shared work within this site allowed the contractor's engineers to re-design the work in this area for maximum efficiency and reduced cost. This scheme also allowed the contractor to send the TBM to the Herrenknecht factory in Germany for remanufacturing as they simultaneously restored/excavated the two contiguous drop shaft sites.

The Tunnel Odor Control Facility was inspected and appeared to be functionally operational, without any apparent odors.

5.3.1.4.2 FIRST STREET TUNNEL AND TEMPORARY PUMPING STATION

Following four severe summer storms in 2012 that caused flooding throughout the Bloomingdale neighborhood, DC Water and the District government accelerated and modified the First Street Tunnel to mitigate flooding in the area. This modification required a temporary pumping station to dewater the First Street Tunnel, which acts as stormwater storage until the NEBT is completed and the temporary pumping station is demolished. This expedited construction within a tight urban setting was completed in October 2016. $58M of the project cost is being reimbursed to DC Water by the District over a ten-year period.



Condition Assessment

A site assessment was performed from the surface. The air release chambers were viewed from above and it was noted that the grates over the chambers were all in good condition. Some of the lifting rings seemed to show signs of corrosion. Still evident are the decommissioned McMillan water treatment plant sand filters on this historical site. This location serves as the headworks for the First Street Tunnel. There is a small amount of landscaping to be finished on this site. The contractor stabilized the area around the structures for future maintenance by using a cellular confinement system that will allow vehicular traffic while also limiting impervious surface, a noted concern in an area with flooding potential. The electrical/mechanical control center facing First Street was designed and built for easy access of personnel and equipment from the street and blends well with the streetscape.

All construction efforts in the neighborhoods for the First Street Tunnel and temporary pumping station have been completed. The only visible signs of work having occurred in this community are the surface access hatches and manholes. The pavement and sidewalk restoration work is noteworthy and indicative of the success of this project that included proactive community participation.

5.3.1.5 BLUE PLAINS DEWATERING PUMPING STATION AND ENHANCED CLARIFICATION FACILITIES (DIVISION Y)

The Blue Plains Tunnel Dewatering Pumping Station (TDPS) and the Enhanced Clarification Facility (ECF) are part of the TN/WW Plan under the modified Consent Decree. During wet weather events these facilities will receive and pump the combined sewage effluent from storage in the tunnel system to treatment in the ECF. The effluent of the ECF can either vector to Outfall 002 (Blue Plains) or to the secondary processes within Blue Plains for dry weather processing. The launching of Lady Bird TBM was at the bottom of the TDPS. Subsequently the TDPS was built over the terminus of the tunnel and then the ECF was constructed at ground level as a vertical structure, similar to other facilities at Blue Plains.

The TDPS/ECF is essential to the March 22, 2018 commissioning of the ART facilities coming on line. The inspection of March 5, 2018 found the large, complex facilities under going operational testing. The TDPS is a significant engineering achievement within the large and highly visible Clean Rivers Project.

Condition Assessment

5.3.1.5.1 TUNNEL DEWATERING PUMPING STATION

The TDPS is operational. All six levels were inspected, and it was evident that it was an active construction site with some housekeeping required inside the below-ground station and on the surface (where there is still quite a bit of small equipment and materials). The size and complexity of the work comprising this structure were notable to the assessment team. The contractor's superintendent pointed out structural and mechanical achievements that solved conditions associated with very large equipment and structures capable of pumping and treating 225 mgd of combined sewer flow. There were no workers within the structure at the time of the inspection. All systems, including Life Safety, were completed. The TDPS/ECF is operational and can be safely occupied. There are remaining completion punchlist items to be performed such as removing the construction elevator, construction equipment and plywood protecting the metal stairways.


JMT Photo

5.3.1.5.2 ENHANCED CLARIFICATION FACILITY

The Enhanced Clarification Facility (ECF), located on top and surrounding the TDPS is also operational with treatment process testing occurring. Outstanding work items at the time of the inspection appear to be minor in comparison to the scale of the project. Clean Rivers and the contractor's superintendent both conveyed that the facility is expected to be commissioned in a ceremony with the Mayor's office before the LTCP deadline of March 23, 2018.

SECTION 6 SECURITY

6.1 OVERVIEW

Historically, DC Water has had a security presence at Blue Plains and other major facilities typical of other large and significant campuses in the DC Metro Area. Since the events of 9/11/2001, Vulnerability Assessments for water utility agencies have identified and developed best practices to safeguard the United States' drinking water and wastewater facilities. Both DC Water and the Washington Aqueduct have invested significantly in physical security measures and have developed best practices with an increased presence of security personnel.

The Department of Security has 9 full-time employees (FTEs) and the Director of Security reports to the Assistant General Manager, Support Services. The FY 2018 Operating Budget for the department is $7.5M, increased from $6.9M in FY 2017. The increase is mainly in contractual services and the transfer of 2 FTEs from Facilities group. The department is well managed and maintains a high degree of training and high morale. The department administers program development, implementation and evaluation of the DC Water's security program. This program strives to achieve the highest level of security for both staff and assets while maintaining a low risk of loss and liability to DC Water and its customers.

During a March 2, 2018 interview, the Director of Security explained in detail the goals and objectives of DC Water to ensure continued operations of both the water and sewer systems in order to keep the federal government operating within the District and not having to disrupt operations by transferring to emergency offsite locations. This mission of serving the large federal government presence increases the role of security at DC Water beyond the benchmarks for other utilities where the important, and shared, benchmark is that of ensuring the public health within a utility's customer base. This additional benchmark mainly requires a more significant safeguard for sanitary services.

DC Water has developed and implemented a comprehensive Emergency Management Plan (EMP) under the auspices of the Emergency Management Chief under the Director of Customer Care and Operations. The EMP contains procedures and scenarios to safeguard the mission of DC Water under emergency conditions. EMP details how DC Water will respond to an emergency. It contains planned actions based on emergency conditions.

6.2 PHYSICAL SECURITY

6.2.1 CAPITAL IMPROVEMENT BUDGET

A new Security Facility was completed in FY 2016 as part of the new Inventory Warehouse project at Blue Plains. The total project cost was $18.4M. Additional capital projects involved both water and sewer facilities security upgrades. Security upgrades started in FY 2010. Some components of the security improvements have been completed while others are scheduled for completion between FY 2020 – FY 2022.

The water system security projects upgrade security systems at water pumping stations, water storage reservoirs and elevated tanks, and other water distribution system structures and sites. Components consists of installing CCTV cameras, access card readers, intrusion sensors, fencing, network and communications, and other control surveillance devices and systems to protect the water facilities and infrastructure against vandalism, criminal activity, and possible future terrorism while protecting DC Water personnel in accordance with the recommendations of the Vulnerability Assessment (VA) Study. The combined capital projects have a Lifetime Cost of $4.2M.

The Sewer Facilities projects provide for a security assessment, placement of exterior and interior cameras throughout Sewer Services Facilities, installation of traffic control devices to include bollards & speed bumps, and installation of perimeter fencing and barriers. The Lifetime Cost in the FY 2017 – FY 2026 CIP is a combined $3.3M.

Capital Equipment outlays in the FY 2017 – FY 2026 CIP are $1.4M for the ten-year program. These funds are for infrastructure connectivity, cameras, card readers, door/window/hatch sensors, fence-line detection systems, automated entry/exit data capture and software support.

6.2.2 FACILITIES CONDITION ASSESSMENT

During the interceding years between Independent Engineer Reviews, the physical security measures have been inspected and reviewed on numerous occasions and for other DC Water assessment tasks. The physical measures are maintained and provide an appropriate level of control. The March 2, 2018 escorted tour of the Security Facility reviewed in detail the supervisory control center and security capabilities supported by the physical plant and assets.

6.3 SECURITY OPERATIONS

6.3.1 OPERATIONS

Security forces providing DC Water security presence and measures are contracted to a licensed protective services firm. DC Water and its contractor have police powers to arrest within the District. Total contractual costs for security in FY 2018 are $3.8M. The Security Director estimates a cost of $300,000 per each 24-hr manned station at the various facilities. The 157 security guards are armed. This is an increase from 50% armed over the last several years as security measures evolve from having a presence to being an effective deterrent.

The functions of staff and contractual services are:

- Identification and Badge Control Electronic security asset testing and maintenance
- Guard force and traffic management
- Management of the security-related CIP
- Emergency Management & First Response and community awareness/training

- Loss prevention, asset protection, vulnerability assessments, and hazardous threat training/awareness
- Investigations, local and federal liaison, and security work order requests
- Information security and site surveys

A key metric in the successful security operations is the low turnover rate in the contracted security forces. The turnover rate for 2018 has been lowered to 10%, which is lower than industry-wide turnover exceeding 25%. The low turnover rate experienced prevents higher training costs and productivity interruptions. This allows for competitive bidding as security agencies recognize the attractive working environment for the regional security workforce.

6.3.2 DEPARTMENT OF HOMELAND SECURITY (DHS)

DHS conducted a Site Assistance Visit to DC Water during the week of November 13, 2013. The evaluation of security and resilience postures, along with providing guidance in mitigating vulnerabilities, were the main objectives of the assistance. The wastewater collection system was the targeted facility. Over 22 sites were evaluated. **Exhibit 6-1** has been taken from the December 20, 2013 DHS report (which is the DHS report's Figure 9). This exhibit shows five categories as utility sector 'highs' with an overall DC Water Protective Measures Index of 74 out of 100 whereas the average for 25 other pump stations assessed elsewhere was 39 out of 100.

Exhibit 6-1: Preventive Measures Index – DC Water

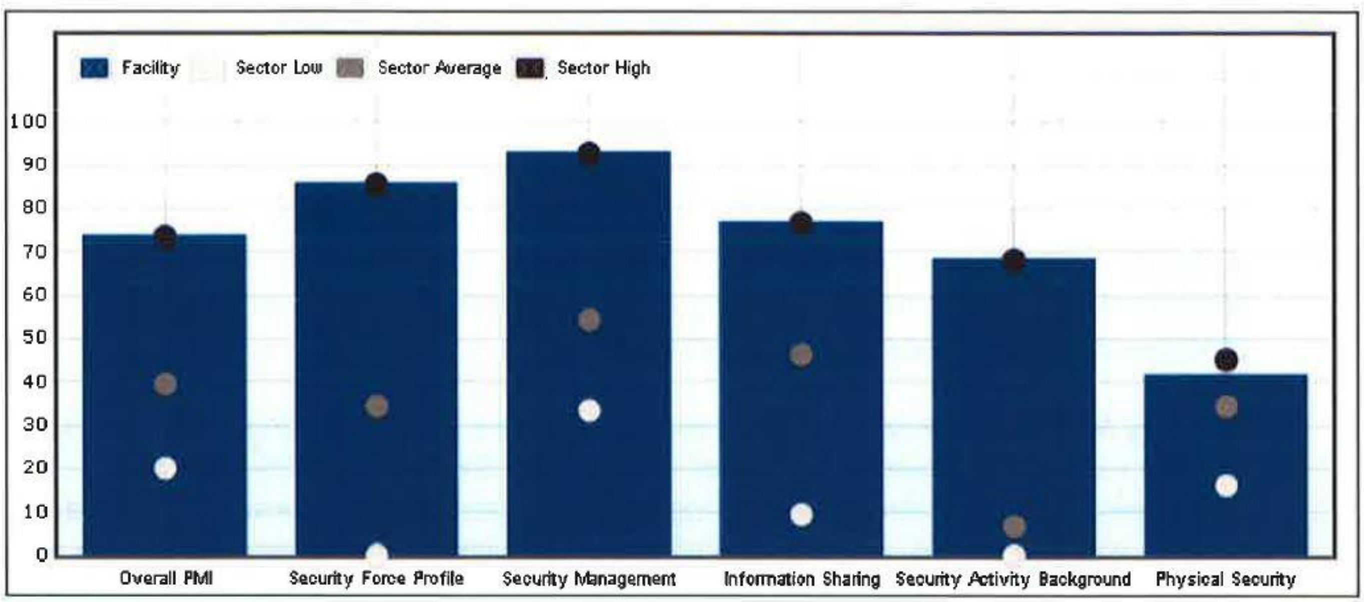


Figure 9 Overall PMI Summary

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